1956

Financial organization in farmer cooperatives

Wilbur Richard Maki
Iowa State College

FINANCIAL ORGANIZATION IN FARMER COOPERATIVES

by

Wilbur Richard Maki

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major Subject: Agricultural Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

Head of Major Department

Signature was redacted for privacy.

Dean of Graduate College

Iowa State College
1956

TABLE OF CONTENTS

	Page
INTRODUCTION	1
Farmer Cooperatives in Iowa	3
Financing Problems of Iowa Cooperatives	5
Objective of the Study	11
Sample and Procedure	12
FINANCING RESOURCES OF COOPERATIVE ELEVATOR ASSOCIATIONS	17
Economic Nature of the Farmer Cooperative	17
Sales, Operating Proceeds, and Cash Flows in Cooperative Elevator Associations	40
Financing Sources in Cooperative Elevator Associations	54
FINANCING AND PRODUCTION REQUIREMENTS	59
Analytical Models and Procedures for Estimation of Production and Financing Requirements	59
Structure of Resource Requirements	61
VALUATION OF FINANCING AND MERCHANDISING GROUPS	75
Analytical Models and Procedures for Estimation of Unit Values of Specified Activities	75
Estimated Unit Values of Specified Activities	76
FINANCIAL AND MERCHANDISING PROGRAMMING	84
Logical Bases of Financial Planning in the Cooperative Association	84
Application of Linear Programming to Financial Planning in Cooperative Associations	91
Summary Matrix and Programming Operations	102
FINANCIAL ORGANIZATION IN SELECTED FINANCING SITUATIONS	111
Financial Management in the Transitional Period	111
Financial Planning in the Terminal Period	116
EVALUATION OF RESULTS	125
Basic Data	126
Analytical Model	130
Application	134

SUMMARY AND CONCLUSIONS 149

ACKNOWLEDGEMENT 153

APPENDIX 154

INTRODUCTION

Financial management and planning in a farmer cooperative involve the intelligent application of technical and practical knowledge to the operation and control of an agricultural business establishment. They involve, moreover, a combination of practices and policies that are different from those applicable to the ordinary corporate form of business. But these practices and policies, which are discussed in the following chapter, have a general application to the different kinds of farmer cooperatives, e.g., grain elevator, creamery and petroleum associations.

The practice of financial planning may occur at two levels of operation--the management level and the policy level. The manager, who is hired by the farm members through their elected board of directors, manages the day-to-day business operations of the cooperative, including its working capital accounts. The cooperative must have enough capital on hand or in the bank to pay the normal business obligations when they fall due. But an optimum level of cash balances involves a complex of considerations, including optimum inventory levels, optimum level of credit extended to patrons, optimum quantity and combinations of plant and equipment and an optimum level of investment in regional marketing and purchasing associations. Financial planning at the management level, therefore, is a part of the management problem; it involves the anticipation of day-to-day financial requirements of the cooperative business.

Financial planning at the policy level is a responsibility of the membership and the directors of the association. They may, and usually do,

draw on the counsel of the manager, particularly in regard to the capital expenditures program, which may lead to additional financing. The member-owners, through their board of directors, have responsibility for both long-term or policy aspects of financial planning, i.e., the capital expenditures program, and the financial structure of the cooperative. If the membership depends on the manager for the capital expenditures program, and then fails to provide the financing to accomplish this program, the membership may be regarded as defunct in its responsibilities. But a membership that provides the necessary financing and yet fails to consider the capital expenditures program in terms of the need for that program by the individual participating farm members, is also defunct in its responsibilities. Long-term financial planning, therefore, requires the participation of the membership and their directors in the development of a capital expenditures program for the cooperative and the development of a financial structure to provide the necessary financing; the latter in a way that is consistent with the economic interests of the participating members.

The need for financial planning in the farmer cooperative stems in part from the past growth of the cooperative agricultural businesses and the possibilities that exist for further growth and expansion. At the beginning of the post-war period, in 1946, the total investment of farmers in the United States in cooperatives amounted to 1.4 percent of their total assets. The percentage of investment in cooperatives increased to 1.8 percent by 1954, although the value of total farm assets increased rapidly during the eight year period. Thus, about 2.8 billion dollars of the 160.9 billion dollars of farmers' assets were accounted for by investments in

cooperatives, i.e., farm member equities in cooperative associations. In comparison, however, U. S. Savings Bonds held by farmers were valued at 5.2 billion dollars in 1954.[1] Farmers' preferences for investment affect the financing possibilities of cooperatives and limit their expansion in the national economy.

Farmer Cooperatives in Iowa

Farmer cooperatives are relatively more important in the agricultural business economy of the State than are farmer cooperatives in the Nation as a whole. In grain marketing, butter production and distribution of selected farm supplies, e.g., petroleum, farmer cooperatives handle a substantial part of farmers' marketing and purchases. In the last marketing season for which data is available--the 1952-53 marketing season, farmers' marketing and purchasing associations handled 550 million dollars of sales, including 435 million dollars of sales by marketing associations (Table 1). The volume handled per member varied by type of cooperative as follows:

Type or commodity	Total dollar sales per member
Grain and beans	1,450
Dairy products	1,610
Livestock	3,000
Miscellaneous	970
Purchasing	760

Although the volume of sales handled per member is large, substantial opportunity for expansion exists within each commodity, even among farmers who are already members. The 434.6 million dollars of sales through local

---

[1] U. S. Department of Agriculture. Agr. Research Service. The balance sheet of agriculture. Agr. Info. Bul. 145. 1954.

Table 1. Farmers' marketing and purchasing associations in Iowa. Number, estimated memberships and estimated business, by specified group, 1952-53 marketing season[a]

Groups	Listed associations	Estimated members[b]	Estimated value of sales
	(number)	(thousands)	(million dols.)
Grain and beans	261	103.7	150.3
Dairy products	251	83.6	134.3
Livestock	48	45.5	136.4
Miscellaneous	15	13.2	13.6
Total marketing	575	246.0	434.6
Purchasing	136	151.7	115.9
Total	718	398.6	550.5

[a]Anne L. Gessner. Statistics of farmer cooperatives. Farmers Cooperative Service, General Report No. 15. 1955.

[b]Estimated for 1951-52 marketing season

cooperatives represented about 25 percent of the total value of farm marketings per farm in Iowa during this period.

The post-war growth of farmers' cooperatives in Iowa may be illustrated by the percentage increase in memberships and gross sales over the eight year period, 1945-46 to 1952-53, as follows:[2]

Type or commodity	Percent increase in members	Percent increase in gross sales
Grain and beans	57	63
Dairy products	6	59
Livestock	61	92
Miscellaneous	45	56
Purchasing	20	642

[2]Prepared from data presented in Table 1 and the following publication: Grace Wanstall. Statistics of farmers' marketing and purchasing cooperatives, 1945-46. Farm Credit Administration, Misc. Report 119. 1948.

Subsequent discussion and tables will show that most of the increase in gross sales value over the eight year period is the result of increased volume of sales. A relatively large percentage of the increase in the value of supplies purchased, however, is the result of unit price increases. The actual dollar increases are important in financial planning inasmuch as they require additional short-term and long-term financing.

Financing Problems of Iowa Cooperatives

The specific problems involved in financing farmer cooperatives may be differentiated by commodity groups. The elevator and petroleum associations, which were established on Rochdale principles, depend on allocated patronage refunds and surplus for a major part of their financing. Current liabilities are minimized. In comparison, current liabilities are more important as a source of short-term capital for creameries, which practice pooling according to the Danish plan. The dairy farmer has daily delivery of milk and, therefore, has no incentive to choose a particular time for marketing or purchase as in the case of the farmer selling grain (or purchasing farm supplies). The latter can wait for the best price and when they do make a sale, they want to be paid in cash.[3]

Cooperative associations differ in their specific financing requirements. The demand for cash in the cooperative elevator, for example, is greater per dollar of sales than in the creamery cooperative. The additional financing may be provided by short-term loans, although in some cooperatives long-term capital funds may be tied up to meet seasonal requirements.

---

[3]Frank Robotka. Analysis of Iowa cooperative laws. Unpublished research. Iowa Agr. Exp. Sta. 1954.

The financial structures of the three principal kinds of cooperatives are summarized in Table 2. The financial structures show almost complete dependence on member and equity financing. Approximately 10 percent of the total financing is comprised of accounts payable and loans by creditors who are not members. A part of the 10 percent includes a share of the 98 loans to Iowa cooperatives from the Omaha Bank for Cooperatives for a total of 8,850,915 dollars outstanding on December 31, 1954.[4]

The practice of revolving deferred patronage refunds and patronage deducts, and in some cases, certificates of interest raises a question among creditors regarding the nature of the capital provided by these forms of financing. Is the capital raised in this way loan capital or does it bear the residual risks of the cooperative association?

Careful scrutiny of each financing instrument is necessary to describe the characteristics of the several forms of member equity. But the fact that the member equities are revolved may not invalidate the additional fact that a permanent fund of capital provided by these member equities remains intact as long as the cooperative continues as a going business. The obligations and responsibilities include the bearing of the business risks in the sense that the revolving period may vary with business conditions.[5]

The revolving fund method of financing, i.e., deferred payment of patronage refunds and other equities, involves difficulties in adjusting

---

[4] Omaha Bank for Cooperatives. Annual report, 1954. Omaha Bank for Cooperatives, Omaha, Nebr. 1955.

[5] Charles E. Nieman. Revolving capital in stock cooperative corporations. Law and Contemporary Problems. School of Law, Duke University. 1948. pp. 393-402.

Table 2. Financial structure of selected farmers' cooperative associations. Average amount per association, by specified group, 1953-54 fiscal year

Group	Elevator[a]	Petroleum[b]	Creamery[c]
		(thousand dollars)	
Current liabilities	21.8	22.4	25.7
Bank loans and building notes	7.6	6.0	3.2
Certificates of indebtedness and interest	0	8.8	2.5
Allocated patronage fund and deducts	98.3	60.7	19.3
Memberships and capital stock	26.1	19.8	4.2
Surplus and reserves	46.4	45.1	33.9
Total	200.2	162.8	89.8

[a]Based on financial statements of 198 cooperative elevator associations for fiscal year ending July 1, 1953, to June 30, 1954.

[b]Based on financial statements of 18 cooperative petroleum associations for fiscal year ending January 1, 1954, to December 31, 1954.

[c]Based on financial statements of 68 cooperative creamery associations for fiscal year ending January 1, 1954, to December 31, 1954.

the financial structure to varying levels of sales. When sales are at a high level and patronage refunds are also at a high level, difficulties are incurred in subsequent years when sales and patronage refunds are at a lower level. One year's patronage refunds in the latter period replace only part of one year's patronage refunds in the former. Hence, the revolving period must be extended to maintain a constant level of funds. Also, a limit in the size of the fund is reached when the revolving period reaches a critical number of years.*

Membership relations in the cooperative association are strengthened or weakened by the way in which the financing of the cooperative activity is accomplished. An Iowa cooperative association usually includes members at different stages in the life and farm ownership cycles. There usually are capital-short farmers and farmers who are willing to make investments outside their farm enterprises. The members include (1) young farmers just getting started, (2) farmers whose capital has been depleted by misfortune, (3) farmers who have an unexpected need for capital for personal requirements or for investment outside their farm business, and (4) farmers who cannot save and who may have over-invested in their farm business.[6] Financing methods may have to be devised to provide for the capital-short member in the cooperative and yet provide for adequate sources of financing without discriminating against other farm members.

---

*Experience in Iowa with the revolving fund method of financing shows that when the revolving period exceeds five to seven years, the membership becomes dissatisfied with the prospect of cash payment of the deferred refunds, particularly when members have prepaid income taxes on these deferred refunds.

[6] H. E. Erdman. Shifting the financing burden among members of cooperatives. Washington, D. C., American Institute of Cooperation. 1947. pp. 562-566.

The relative capital positions of farmers in North Central Iowa may show the need for different forms of financing to tap the available financial resources of the cooperative association. The owner-operator may have much of his capital funds tied up in land and as a result he may have severe limitations on available capital for equipment and livestock (Table 3). The renter, on the other hand, has no investment in land and he, also, may be severely limited in his equipment and operating capital. The part-owner is in an intermediate capital position, but he may have a desire and the know-how to profitably use much more capital funds.

Table 3. Average balance sheet per farm in North Central Iowa, by specified group and tenure, July 1, 1954[a]

Group	Owner operator	Part-owner	Renter	All operators
Assets				
Machinery, livestock and inventory	11,258	18,116	12,478	12,736
Land	41,154	35,934	0	20,238
Total assets	52,412	54,050	12,478	32,974
Liabilities				
Loan	366	1,822	927	828
Mortgage	2,706	6,641	0	1,878
Total liabilities	3,072	8,463	927	2,706
Equity	49,340	45,587	11,551	30,268
Total liabilities and equity	52,412	54,050	12,478	32,974

[a]Unpublished data from study on use and acceptance of fertilizer in Iowa. Iowa Agr. Exp. Sta. 1954.

The alternative investment choices of farmers with 1,000 dollars to invest vary according to the capital position of the farmer (Table 4). The group with assets of less than 5,000 dollars must repay its debts and build up its operating capital. The group with 50,000 dollars and over of total assets is in a position to improve the farm-home and the quality of the productive assets and build a cash reserve, but it is not faced with an alternative investment in a cooperative association. Investment in assets that are owned and managed by the farm operator is preferred by the farmer to investment outside the farm.

Table 4. Average alternative investment choices per farmer by specified choice and asset group[a]

Alternative investment choice	Less than 5,000	50,000 and over	All groups
		(dollars)	
Cash reserve	90	90	136
Repay debts	200	132	134
Farm home	0	68	48
Buildings	157	307	185
Farm machinery	205	59	136
Fertilizer	124	176	146
Better livestock	14	30	66
More livestock	210	39	93
Terraces	0	1	4
Other	0	97	52
Total investment	1,000	1,000	1,000

[a]Marvin A. Anderson, et al. Factors affecting acceptance and use of fertilizer on Iowa farms. Unpublished research. Ames, Iowa, Iowa Agr. Exp. Sta. 1955.

Cooperatives may need to consider financing obtained from a larger population of investors than the member-patrons of these associations. Financing problems of cooperatives stem in part from their limitation to a local area and to one or two methods and sources of financing. Both limitations are institutional and sociological, and not imposed by law or by the economic nature of the cooperative.

Objective of the Study

It is the purpose of this study to develop an economically sound, consistent and practical approach to financial planning in the cooperative association. The end in view of financial planning in the cooperative is the development of a financial structure that makes possible the highest attainment of the purposes of the association. Solutions to the financing problems outlined in the previous section are involved in a successful financial program. The problematic solutions, however, may be only partial and temporary. But it is hoped that the logic presented in this study may provide analytical tools for dealing with the recurrent problems of financing farmer cooperatives.

The plan of the study, which suggests certain specific objectives, may be outlined as follows:

1. Estimation of the financing resources of farmer cooperatives.
2. Determination of financing and merchandising requirements.
3. Estimation of prices, outlays and earnings of farmer cooperatives.
4. Development of long-range financial programming.
5. Presentation of optimum financial organization for selected financing situations.

The data pertain to cooperative associations handling grain and located primarily in North Central Iowa.* A grain elevator cooperative may handle a variety of farm supplies, as well as engage in grain merchandising and grain storage. Thus, geographic and commodity limitations on the scope of the study will not result in a limited variety of financing problems.** The technique of linear programming, however, may be illustrated simply in terms of the financing situations among the sample elevator associations.[7]

Sample and Procedure

The objective of the sampling procedure was to obtain a sample of elevators at different stages in their growth cycle and a sample of members with different financing preferences and relations with the cooperative. It was hoped that a wide range of variables would be available for correlation and regression analysis. The research procedure involved, therefore, two levels of analysis: (1) the discovery of "new" relationships affecting the financing of cooperatives and (2) the test of hypotheses based on *a priori* knowledge about the nature and operations of the cooperative association.

---

*According to the U. S. Census designation, this area includes the 20 counties that comparise the cash-grain area of Iowa; it is designated as State Economic Area 2.

**Problems peculiar to farmers' creamery associations and certain specialized types of cooperatives, however, are omitted from this analysis.

[7]This study, therefore, involves an extension of the theoretical framework presented in the initial phase of this study. Wilbur R. Maki. Economic framework for financing cooperatives. Unpublished M. S. Thesis. Ames, Iowa, Iowa State College Library. 1954.

The data for this study came from two principal sources: (1) financial statements of 172 farmers' elevator associations from which samples of 86, 32 and 8 elevators respectively, were drawn for increasingly more detailed analyses and (2) survey of 160 farm members of 8 different elevator associations during the period November, 1954 to April, 1955. The geographic distribution of the elevators is shown in Figure 1.

A population of 172 cooperative elevator associations was stratified on the basis of two levels of average total net savings and two levels of change in total assets over a four-year period from 1950 to 1954.* Approximately one-half of the elevators in each cell were randomly selected to comprise the sample of 86 elevators.** The first two elevators randomly selected from each cell were designated for field interview of their respective memberships. The first eight elevators in each cell were designated for both historical and cross-sectional analyses. Finally, the remaining elevators were selected for analyses of their operation over the 1953-54 marketing season.

The sample of 86 farmers' elevator cooperatives are listed by type-of-farming area and financing situation in Table 5. The five type-of-farming areas compare with the five state economic areas used by the U. S.

---

*This population, which includes elevators with comparable audits, comprised about two-thirds of the farmers' elevator associations in Iowa. This sample is believed adequate for the purpose of the study. The elevators included in the population compare closely with those outside the population in geographic distribution and total business handled.

**The sampling rate was slightly larger for the cell including the elevators with high net savings and high change in total assets while it was slightly lower for the cell with low net savings and low change in total assets.

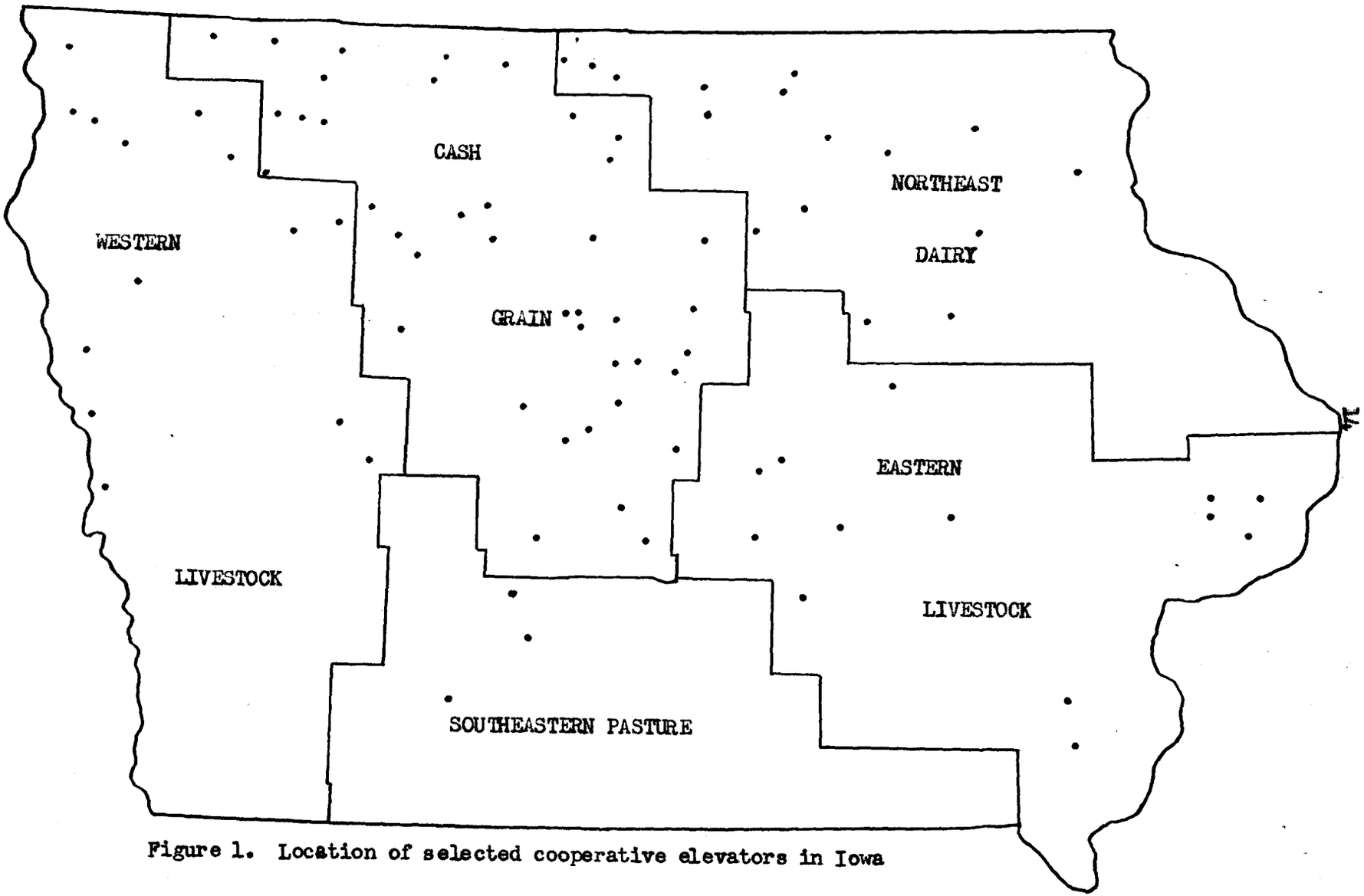

Figure 1. Location of selected cooperative elevators in Iowa

Table 5. Sample of farmers' elevator cooperatives, by type-of-farming area and financing situation[a]

Type-of-farming area	Number of sample elevators by financing situation					Number of cooperative elevator associations		
	Aa	Ab	Ba	Bb	Total	Audited[b]	Other	Total
Western livestock (SEA 1)	7		3	4	14	39	38	77
Cash-grain (SEA 2)	4	12	9	15	40	87	43	130
Southern pasture (SEA 3)			2	1	3	9	10	19
Northeast dairy (SEA 4)	5	2	2	7	16	46	23	69
Eastern livestock (SEA 5 and 6)	5	2	2	4	13	25	26	51
Total	21	16	18	31	86	206	140	350

[a]Prepared from 1955 annual directory. Farmers' Grain Dealers Association of Iowa. Des Moines, Iowa. 1956.

[b]Audited by the Auditing Department, Farmers' Grain Dealers Association of Iowa. Des Moines, Iowa. 1954.

Bureau of the Census.[8] The four financing situations are identified as follows:

Financing situation	Total net savings	Change in assets
Aa	Less than $22,000	Less than $28,000
Ab	Less than $22,000	More than $28,000
Ba	More than $22,000	Less than $28,000
Bb	More than $22,000	More than $28,000

[8]U. S. Bureau of the Census. State economic areas, by Donald J. Bogue. U. S. Government Printing Office. Washington, D. C. 1951.

It may be noted that nearly 60 percent of the elevators in the sample with more than 28,000 dollars change in total assets were located in the cash grain-farming area (State economic area 2).

The membership of the eight elevator associations was stratified on the basis of two levels of capital position and two levels of attendance at annual meetings.* Five members who were active farm operators were selected from each of these four cells, or a total of 20 members per association, were interviewed. Active farm operators included all members engaged in farming and who have farmed 30 acres or more for at least one year and who were 65 years or less of age. The sampling rate and the estimated number of operator members and non-operator members are listed by financing situation in Table 6. The field interviews covered a total of 160 members in eight different associations located in or near the cash-grain farming area (Figure 1).

Table 6. Sample of farm operator members, by financing situation

Group	Financing situation				Average
	Aa	Ab	Ba	Bb	
Operator members	132	231	284	298	231
Non-operator members	135	60	310	313	203
Total membership	267	291	594	611	434
Members interviewed as percent of operator members	15.2	8.8	7.0	6.7	8.7

*The basis for classifying the membership according to capital position was somewhat arbitrary. However, the purpose was not to obtain a precise stratification of the data as basis for further analysis but to assure a wide distribution of membership characteristics, and including members who attend regularly as well as irregularly, despite a relatively small sample.

FINANCING RESOURCES OF COOPERATIVE ELEVATOR ASSOCIATIONS

The economic analysis of the financing problems of cooperative associations follows from an a priori concept of the economic nature of the cooperative association. This concept of the cooperative involves the cooperative business as an integral part of the individual businesses operated by members of the association. Financing the cooperative business is related, therefore, to the financing of the individual businesses of the farm members. In the case of the cooperative elevator association, the financing of the cooperative becomes a part of the problem of financing the total farm operations of the individual farm members.[1]

Economic Nature of the Farmer Cooperative

Robotka has viewed the cooperative association as the sum total of agreements among autonomous entrepreneurial units to operate jointly a

---

[1]The use of a priori knowledge in the form of hypotheses regarding financing decisions in a cooperative association limits the data collecting stage of research. If the a priori knowledge is quite complete and the hypotheses well formulated, the analysis of the data may be accomplished efficiently and with optimum results. But in areas of research where the received knowledge is scattered and inconclusive useful hypotheses are few and inadequate. It is necessary, then, to search for relationships as bases for hypotheses which are subject to empirical tests. In this study cross-sectional and multiple regression analyses are employed to provide information about interrelationships among certain variables that appear relevant to the problem. Gershon Cooper. The role of econometric models in economic research. Journal of Farm Economics. 30:101-116. 1948. Gale Johnson. The use of econometric models in the study of agricultural policy. Journal of Farm Economics. 30: 117-130. 1948.

cooperative activity at cost.[2] The participating entrepreneurs elect a board of directors, hire a manager, finance and patronize the place of business that they own and control--the cooperative activity. But before the business is established, the members who form the association must reach an agreement among themselves to support the joint activity. The members assume the responsibilities of financing and control and they obtain the benefits of integration. Therefore, an analysis of financing the cooperative must start with an understanding of the relationships among members as an association organized in the first place, to perform an economic function--the control of the cooperative activity.

Patronage, ownership and control.

The traditional theory of the firm minimizes the implications of different kinds of internal organization of the firm.[3] In the theory of cooperation, the element of organization is the crux to the success of the joint activity, particularly in the economic and cooperative sense.[4]

---

[2]Frank Robotka. A theory of cooperation. Journal of Farm Economics. 29: 94-114. 1947.

[3]W. W. Cooper. A proposal for extending the theory of the firm. Quarterly Journal of Economics. 65: 87-109. 1951. Revisions to the theory of the firm. American Economic Review. 59: 1204-1222. 1949.

[4]Robotka has pointed to at least three possible meanings of success among cooperatives, i.e., (1) in a business sense, (2) in an economic sense, and (3) in a cooperative sense. Robotka suggests that a cooperative can be a business success and still not be a success either in a cooperative or an economic sense. Frank Robotka. Research on the cooperative organization itself. American Cooperation, 1951. American Institute of Cooperation. Washington, D. C. 1952. pp. 273-282.

Control in the cooperative is in the hands of the owner patrons. Unlike the owners of the ordinary corporation, the owners of the cooperative are confronted with two equally important goals: the entrepreneurial goal and the organizational goal. Traditionally, the entrepreneurial goal involves the maximization of earnings on investment; the organization goal, the maximization of services offered to consumers.[5] And traditionally, the two kinds of goals are in conflict, except under perfect competition. In the case of the owner-patron of the cooperative, the two goals are more consistent with each other than in the traditional case, as long as the joint activity is considered an integral part of the individual business enterprise and profit maximization is in terms of the total business operations rather than a single segment of it.*

Membership in a cooperative association is a prerequisite to the exercise of control in the cooperative. The chief requirements of membership are patronage and the purchase of a membership certificate or stock in the association.[6] The typical farmer in Iowa is a member of three different cooperative associations (Table 7). The members of the cooperative elevators in the survey sample were members in as many as five or more other associations.

---

*If the dominant owner patrons are motivated primarily as owner investors, rather than as owner patrons, the association would function as a farmers' stock company.

[5]Herbert A. Simon. Administrative behavior. New York, The Macmillan Co. 1947.

[6]Membership involves, however, certain obligations, i.e., patronage, sharing of costs and risks, financing and control, as well as the sharing of the benefits of patronage. Richard Phillips. Economic nature of the cooperative association. Unpublished Ph.D. Thesis. Ames, Iowa, Iowa State College Library, 1952.

Only 7.4 percent of farmers in Iowa in 1954 failed to have a single cooperative membership. The survey sample of farm members, although selected from the membership rosters of the elevator cooperatives, has approximately the same pattern of memberships as for the State.

Table 7. Percentage distribution of farm operator members and Iowa farmers classified by number of cooperatives they belonged to and by financing situation.

No. of cooperatives belonged to	Financing situation				Survey average	Iowa average[a]
	Aa	Ab	Ba	Bb		
	(percent)					
0	0	0	0	0	0	7.4
1	28.7	13.5	4.9	5.8	14.3	13.5
2	29.8	28.1	13.5	15.7	22.2	20.0
3	31.0	51.1	20.0	31.8	33.2	23.5
4	6.5	3.9	22.6	38.6	19.0	12.6
5	4.0	3.4	10.4	8.1	6.3	13.9
6 or more	0	0	28.6	0	5.1	9.1
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]July 1, 1954. H. J. Hudek, Report to farmers cooperating in the livestock survey, Iowa and Northern Illinois. Ames, Iowa, Agr. Exp. Sta. September, 1954. (Mimeo.)

The multiplicity of memberships of farmers in cooperative associations is distributed among different kinds of cooperatives. Some farmers, however, are members of more than one cooperative of the same kind. Only one-third of Iowa farmers were members of farmers' elevator associations in 1954, but the percentage of Iowa farmers in other kinds of cooperatives approxi-

mated the membership pattern for the survey sample (Table 8). The small size of sample by financing situations makes comparisons between financing situations subject to a relatively large sampling error. Generally, members of the four larger cooperatives, i.e., cooperatives in financing situations Ba and Bb, belonged to a larger number of different kinds of cooperatives than the members of the four smaller cooperatives.

Table 8. Percentage distribution of sample farm operator members and Iowa farmers belonging to specified kind of cooperative, by financing situation.

Kind of cooperative	Financing situation				Survey average	Iowa average[a]
	Aa	Ab	Ba	Bb		
	(percent)					
Farmers' elevator association	100.0	100.0	100.0	100.0	100.0	31.6
Farmers' creamery	42.3	29.4	49.9	47.4	42.8	26.0
Oil cooperative	0	1.5	48.0	46.7	23.6	23.0
Rural electric cooperative	36.2	61.2	77.8	72.1	59.8	64.4
Farm supply and service cooperative	17.3	22.4	56.8	33.0	30.3	29.8
Livestock shipping association	2.0	0	30.2	0	6.1	2.0

[a]July 1, 1954. H. J. Hudek, Report to farmers cooperating in the livestock survey, Iowa and Northern Illinois. Ames, Iowa, Agr. Exp. Sta. September, 1954. (Mimeo.)

Patronage provides the basis for control in the cooperative association. The principal source of financing, i.e., deferred patronage refunds, depends on the volume of patronage. Analysis of the sales and purchases

of farm members would show the relative importance of different kinds of cooperatives to these farms and the distribution of control among the member patrons. Farm operator members were interviewed on farm sales and purchases over a twelve-month period, including sales and purchases through different kinds of cooperatives. The average farm operator-member sold 2,110 dollars worth of farm products and purchased over 2,150 dollars worth of farm supplies through his cooperative, including 3,690 dollars of sales and purchases through the specified elevator associations (Table 9). The value of sales and purchases per farm operator member was higher in the group of associations with a "high" change in total assets as compared to the "low" group. The elevator cooperatives in the "high" change in total assets group, however, were located among farm operators with a larger volume of business, both in farm sales and farm purchases.

The tenure status of the farm operator members affects his participation in the grain elevator cooperative and other cooperative associations. The size of farm in each tenure group, i.e., owner operator, part owner operator and renter, was higher than for a sample of farms in North Central Iowa (Table 10). The group of elevator associations with the higher change in total assets include larger than average size of farms in the part owner operator group. Moreover, the elevator associations with the higher average total net savings had a membership of larger than average size farms.

The relative importance of each tenure group in each of the four financing situations is shown in Table 11. The percentage distribution of owner operators in the survey sample of 160 farm operator members was approximately the same as for the North Central Iowa sample. But the percentage distribution of part owner operators and renters was approximately

Table 9. Average sales and purchases for a twelve month period per farm operator member, by commodity group and financing situation

Commodity group	Financing situation				Survey average
	Aa	Ab	Ba	Bb	
	(thousand dollars)				
Total sales					
Grain and seed	1.5	2.3	1.3	4.4	2.5
Livestock	8.1	16.0	8.3	14.7	11.7
Dairy products	0.9	1.2	1.5	1.5	1.3
Total	10.5	19.5	11.1	20.6	15.5
Sales through cooperatives					
Grain and seed	0.7	1.2	0.7	1.9	1.1
Livestock	0.2	0	2.2	0	0.5
Dairy products	0.5	0.2	0.5	0.7	0.5
Total	1.4	1.4	3.4	2.6	2.1
Sales through elevator	0.7	0.9	0.4	1.6	1.0
Total purchases					
Grain and seed	1.6	3.6	0.7	1.3	1.7
Livestock	2.0	8.0	1.4	5.9	4.3
Farm supplies	2.5	3.4	2.3	3.6	3.0
Total	6.1	15.0	4.4	10.8	9.0
Purchases through cooperatives					
Grain and seed	0.6	1.4	0.3	0.6	0.7
Farm supplies	0.7	1.4	1.5	2.2	1.5
Total	1.3	2.8	1.8	2.8	2.2
Purchases through elevator	1.1	2.5	1.1	2.1	1.7

Table 10. Average acres per farm by tenure group and financing situation

Tenure group	Financing situation				Survey average	North Central Iowa[a]
	Aa	Ab	Ba	Bb		
	(acres)					
Owner operator	171	191	207	235	202	161
Part owner operator						
Owned	178	194	158	118	157	140
Rented	92	146	90	215	140	119
Total	270	330	248	333	297	259
Renter	154	173	318	267	214	202
All farm operators	190	220	233	333	238	192

[a]Marvin A. Anderson, et al. Factors affecting acceptance and use of fertilizer on Iowa farms. Unpublished research. Ames, Iowa, Iowa Agr. Exp. Sta. 1955.

Table 11. Percentage distribution of farm operator-members classified by tenure group and financing situation

Tenure group	Financing situation				Survey average	North Central Iowa[a]
	Aa	Ab	Ba	Bb		
	(percent)					
Owner operator	29.6	31.0	44.5	38.6	35.5	38.0
Part owner operator	43.2	44.4	34.9	43.6	42.1	12.8
Renter	27.2	24.6	20.6	17.8	22.4	49.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

[a]Marvin A. Anderson, et al. Factors affecting acceptance and use of fertilizer on Iowa farms. Unpublished research. Ames, Iowa, Iowa Agr. Exp. Sta. 1955.

reversed in the two cases. The membership in the sample survey was comprised predominantly of farmers who had at least part ownership in their farms. Yet, about one-half of all farm operators in the North Central Iowa area were renters.

The predominant tenure groups in the grain elevator associations also include farm owners who were not in the farm operator category. Landlords of renters (including part owner operators) were reported as members of the specified elevator cooperatives in 44.2 percent of the cases interviewed, (Table 12). Thus, 69 percent of the members who rented at least part of their farm reported their landlords a member of the grain elevator association to which they belonged. Landlords, owner operators and part owner operators comprise, therefore, 85 percent of the membership in the field survey.

Table 12. Percentage distribution of renters and partners with landlord or partner a member, by financing situation.

Group	Financing situation				Survey average
	Aa	Ab	Ba	Bb	
	(percent)				
Landlord or partner a member	51.6	49.9	18.4	48.3	44.2
Landlord or partner not a member	18.8	19.0	37.1	12.9	20.3
Owner operator	29.6	31.1	44.5	38.8	35.5
Total	100.0	100.0	100.0	100.0	100.0

The equity and investment of individual members in their grain elevator association is a measure of their financial support of the cooperative business activity. The equity of members in the form of deferred patronage refunds varied from less than 50 dollars to nearly 2500 dollars (Table 13). The modal group among members who were able to make an estimate of their equity was in the range of 100 to 249 dollars. Nearly one-third of the members, however, were unable to make an estimate of the total value of their deferred patronage refunds in a specified grain elevator association.

Table 13. Percentage distribution of members classified by total value of deferred patronage refunds and by financing situation

Total value	Financing situation				Survey average
	Aa	Ab	Ba	Bb	
	(percent)				
Under 50 dollars	6.5	2.4	18.0	12.9	9.8
50 to 99 dollars	11.8	11.2	17.8	8.8	11.8
100 to 249 dollars	24.0	31.0	21.2	25.0	25.2
250 to 499 dollars	7.9	9.6	5.6	18.6	11.2
500 to 2499 dollars	8.2	29.4	0	5.0	9.8
No response	41.6	16.4	37.4	29.7	32.2
Total	100.0	100.0	100.0	100.0	100.0

Member investment in their grain elevator associations, in the form of preferred stock or building notes was limited to 25 percent of the farm operator membership. The typical member investor in the elevator cooperative owned 50 to 99 dollars worth of preferred stock or building notes. Members holding building notes were interviewed in only 2 of the 8 associations. Preferred stock, however, was more widely held, as shown in Table 14. Only 5.8 percent of farm operator members in the sample held building notes but 21.2 percent of the farm operator members held one or more shares of preferred stock.

Table 14. Percentage distribution of members classified by total value of preferred stock held and by financing situation

Total value	Financing situation				Survey average
	Aa	Ab	Ba	Bb	
	(percent)				
None	97.8	68.5	77.7	74.6	78.8
Under 50 dollars	2.2	0	11.7	10.4	6.0
50 to 99 dollars	0	25.4	2.4	10.0	8.5
100 to 249 dollars	0	6.1	7.7	3.8	3.8
250 to 499 dollars	0	0	5.5	6.2	2.9
Total	100.0	100.0	100.0	100.0	100.0

A third measure of control in a cooperative association is the level of attendance at the annual membership meetings. The pattern of attendance by financing situation, is summarized in Table 15. It may be noted that nearly one-third of the farm operator membership had failed to attend a

single annual meeting during the five year period, 1950 to 1954. Attendance was high in financing situation Aa because of a recent proposal to erect additional storage facilities. Expansion and growth generally are associated with increased attendance at annual meetings.

Table 15. Percentage distribution of farm operator members classified by last annual meeting attended and by financing situation

Last annual meeting attended	Financing situation				Survey average
	Aa	Ab	Ba	Bb	
	(percent)				
1954	52.2	33.3	32.6	32.8	39.0
1953	7.2	36.4	14.3	29.5	21.1
1952	7.3	6.0	2.0	0	3.8
1951	0	0	9.6	8.5	4.4
1950	0	0	4.9	0	0.9
Non-attendance	33.3	24.3	36.6	29.2	30.8
Total	100.0	100.0	100.0	100.0	100.0

Farmer attitudes toward financing their elevator associations.

The characteristics of the farm operator members are summarized in this sub-section according to their attitudes in financing their elevator association. Member attitudes on disposition of net savings and investment in their cooperative were observed to differ as the following characteristics varied: (1) number of memberships in cooperatives, (2) farm size in acres, (3) age of operator, and (4) tenure status.*

*Membership scores were derived to measure four aspects of member relationships, i.e., participation, understanding, knowledge, and satisfaction, but scores were inconclusive with regard to financing attitudes.

Member attitudes on cash payments from patronage refunds are suggested by the number of farm operator members who count on receiving cash payments from patronage refunds (Table 16). Only 28 percent of the 160 farm operator members interviewed did count on receiving cash payments from patronage refunds. This group of respondents had more memberships in cooperatives, larger farms and they were several years older on the basis of simple mean comparisons. The irregularity of cash payment as a result of longer and longer revolving periods require membership experience in several cooperatives, more than average volume of business with the cooperative, and a history of patronage to provide a basis for an affirmative response to this question.

Table 16. Cash payments from patronage refunds. Selected characteristics per farm operator member by specified group

Group	Respondents	Memberships	Farm size	Age of operator
	(number)	(number)	(acres)	(years)
Count on receiving cash payments from patronage refunds	44	3.6	243	48
Do not count on receiving cash payments from patronage refunds	116	3.0	206	43
Total	160	3.1	216	45

The attitude of members to the disposition of net savings was probed with a question on the use of net savings (1) retire oldest deferred refunds first, or (2) pay part of current refunds in cash to help pay income taxes on these refunds (Table 17). Only 21 percent of the respondents preferred to use even a part of each year's net savings as a cash payment on current patron's refunds. The usual practice of retiring the

oldest deferred refunds first, despite the length of revolving period or the income tax obligations of members, was preferred by 70 percent of the respondents. The 21 percent who did not favor the current practice in disposition of net savings may include the capital-short farmer who limits his participation in cooperatives for this reason (Table 17). Non-member farmers may need to be interviewed to ascertain the practical effects of this practice on membership and participation.

Table 17. Disposition of net savings in patronage refunds. Selected characteristics per farm operator member by specified group

Group	Respondents	Memberships	Farm size	
			Owned	Total
	(number)	(number)	(acres)	(acres)
Retired oldest deferred refunds first	111	3.3	95	211
Pay part of current refunds in cash	34	2.8	144	231
No response	15	2.7	67	245
Total	160	3.1	102	216

A third approach to an assessment of member attitudes in financing may involve a choice among optional ways of handling the deferred patronage refunds of members. It was found, however, that only 24 percent of the members interviewed would choose to convert their deferred patronage refunds into preferred stock (Table 18). Investment in preferred stock is tied-up in the cooperative for a longer period than deferred patronage refunds. Members who patronize a larger than average number of cooperatives and have a larger than average volume of farm sales and purchases

Table 18. Conversion of deferred refunds into preferred stock. Selected characteristics per farm operator member by specified group

Group	Respondents	Memberships	Farm size
	(number)	(number)	(acres)
Would prefer to convert	38	3.8	234
Would not prefer to convert	108	3.2	213
No response	14	2.6	192
Total	160	3.1	216

handled through the cooperative may prefer an interest return on their present equities in cooperatives.

The 160 farm operator members in the survey were questioned regarding what they thought the relative returns were on a dollar invested in the cooperative as compared to a dollar invested in the farm (Table 19). The relative subjective returns varied directly with the number of memberships in cooperatives and inversely with farm size. Financing attitudes, however, may not depend in an important way upon relative subjective returns of alternative opportunities. These returns may be related, on the other hand, to a member's attitude toward participation in the cooperative.

Finally, members were questioned whether or not they would provide as much capital in cash as they have in deferred patronage refunds (Table 20). Nearly two-thirds of the members answered in the negative to this question. Farm operator members who have profitable alternative investment opportunity on their own farms prefer to allocate available cash funds into these investments rather than to purchase securities issued by the cooperative.

Table 19. Estimated relative amount of added farm income per dollar of deferred refunds as compared to a dollar invested in the farm by specified group

Group	Respondents	Memberships	Farm size
	(number)	(number)	(acres)
Deferred refunds adding less	42	2.9	238
Deferred refunds adding as much	71	3.1	212
Deferred refunds adding more	34	3.5	199
No response	13	2.8	211
Total	160	3.1	216

Table 20. Member investment in the cooperative. Selected characteristics per farm operator member by specified group

Group	Respondents	Farm size
	(number)	(acres)
Would provide as much capital in cash	34	196
Would not provide as much capital in cash	105	218
Conditional response	21	238
Total	160	216

Farmer preferences and financing limitations.

The preliminary probing of farmer attitudes suggest important differences among an association of farmers in their attitudes toward financing their elevator associations. It may be hypothesized that if farm members are presented with two clear-cut alternative investment opportunities and allowed to choose between them, it would be possible to measure the preference for one over the other as a single factor is varied, e.g., expected returns on each investment. In the field interview each respondent was questioned on the amount of money he would transfer from a safe investment, e.g., U. S. Savings Bonds, drawing a stipulated interest return, in 500 dollar amounts and transfer as an investment (a) in his farm, and (b) in his elevator association. It was indicated further that the expected (normal) net returns or benefits would be the same for an equivalent total investment in the farm or in the cooperative.

The rate of return for each additional 500 dollars invested in the farm or in the cooperative varied as follows:

Added $500 investment	Percent return	Added $500 investment	Percent return
1st	35	11th	11
2nd	30	12th	10
3rd	25	13th	9
4th	22	14th	8
5th	20	15th	7
6th	18	16th	6
7th	16	17th	5
8th	14	18th	4
9th	13	19th	3
10th	12	20th	2

Hence, an equilibrium between the safe investment and the alternative investments in terms of net return on each additional dollar of investment

would be attained with an alternative investment of 9,500 dollars, 8,500 dollars, 7,500 dollars, and 6,000 dollars, respectively, with a return of 3 percent, 5 percent, 7 percent, and 10 percent on the safe investment.

Two elements are confounded in the decision-making process: (1) a decrease in the total amount of the initial 10,000 safe investment with each 500 dollar withdrawal, or an increase in the total alternative investment, and (2) a decrease in the average marginal return on each additional 500 dollars of the alternative investment. An interpretation of the response of members interviewed must take account of this difficulty.

An examination of Table 21 reveals a consistently sharp decrease in the amount invested in the farm with an increase in the interest rate on the safe investment. The comparable marginal returns at each level of investment are as follows:

Dollars invested in farm	Marginal return on farm investment	Marginal return on safe investment
6,700	9	3
5,100	12	5
3,200	17	7
1,400	26	10

Equilibrium levels of investment in the safe investment and in the farm would occur at marginal return rates that are nearly three times as large on the farm as for the safe investment.

The pattern of withdrawals from the safe investment to investment in the cooperative differs from that summarized in Table 21. The investment pattern in Table 22, differs by ownership group and age group. Moreover, the average level of investment in the cooperative at specified interest rates on the safe investment is lower than for the farm, varying as follows:

Table 21. Investment preference of farm members. Average amount per member transferred to farm from a safe investment of 10,000 dollars, by specified interest rate, land ownership group and age group[ab]

Land ownership group		Age group: Low age	High age	Total
			(thousand dollars)	
Low ownership	(1)	6.7 (53)	6.3 (24)	6.4 (77)
	(2)	5.4 (53)	4.4 (24)	5.1 (77)
	(3)	3.8 (52)	2.5 (24)	3.4 (77)
	(4)	1.7 (53)	1.0 (23)	1.5 (76)
High ownership	(1)	7.0 (26)	6.8 (49)	6.9 (75)
	(2)	5.3 (26)	5.0 (48)	5.1 (74)
	(3)	3.0 (26)	2.9 (48)	2.9 (74)
	(4)	1.2 (26)	1.3 (48)	1.3 (74)
Total	(1)	6.8 (79)	6.6 (73)	6.7 (152)
	(2)	5.3 (79)	4.8 (72)	5.1 (151)
	(3)	3.5 (79)	2.8 (72)	3.2 (151)
	(4)	1.6 (79)	1.2 (72)	1.4 (151)

[a]Interest rates on the safe investment are as follows: (1) 3 percent; (2) 5 percent; (3) 7 percent; (4) 10 percent.

[b]Data in parentheses are the number of respondents for the specified group, by age and ownership and interest rate

Table 22. Investment preference of farm members. Average amount per member transferred to cooperative from a safe investment of 10,000 dollars, by specified interest rate, land ownership group and age group[ab]

Land ownership group		Age group		
		Low age	High age	Total
		(thousand dollars)		
Low ownership	(1)	5.2 (53)	3.2 (24)	4.6 (77)
	(2)	4.2 (52)	2.5 (24)	3.7 (76)
	(3)	3.0 (52)	1.5 (23)	2.5 (75)
	(4)	1.9 (52)	0.7 (23)	1.5 (75)
High ownership	(1)	5.4 (24)	3.0 (53)	3.8 (77)
	(2)	4.1 (24)	1.8 (52)	2.5 (76)
	(3)	3.7 (25)	1.1 (52)	1.6 (77)
	(4)	1.6 (25)	0.7 (52)	1.0 (77)
Total	(1)	5.3 (77)	3.1 (77)	4.3 (154)
	(2)	4.2 (76)	2.0 (76)	3.2 (152)
	(3)	2.9 (77)	1.2 (75)	2.2 (152)
	(4)	1.8 (77)	0.7 (75)	1.3 (152)

[a]Interest rates on the safe investment are as follows: (1) 3 percent; (2) 5 percent; (3) 7 percent; (4) 10 percent.

[b]Data in parentheses are the number of respondents for the specified group, by age and ownership and interest rate.

Dollars invested in cooperative	Percent return on cooperative investment	Percent return on safe investment
4,300	13	3
3,200	17	5
2,200	21	7
1,300	27	10

The marginal benefits derived from the investment in the cooperative are three to four times as large as for the safe investment at the equilibrium levels. The high ownership, high age group, however, discounted their alternative investment at a higher rate than the average discount for the sample. The percent return (net benefits) on the investment in the cooperative varied from 18 percent to 33 percent, which amounted to a level of marginal net benefits three to six times as large as for the safe investment. The low age group failed to discount an investment in their cooperative differently from an equal investment in their farm, as shown by a comparison of Table 21 and Table 22.

The sample of farm members were asked the amount that they would be willing to have their cooperative borrow at specified interest rates, if the total assets of their cooperative were valued at 200,000 dollars. A cross-tabular analysis on the basis of land input, land ownership and age suggests a willingness on the part of the younger farm operator, with low ownership and low land input, or with high ownership and high land input, to allow the cooperative to go further into debt than would the remaining groups of farm members (Table 23). The most conservative farm members appear to be the older farm operators with low ownership and low land input. In comparison, the moderately conservative farm operators appear to be (1) the younger farm operators who have only a small amount of work-

Table 23. Finance preference of farmer members. Average amount which should be borrowed to finance a 200,000 dollar elevator by specified interest rate, land input group, land ownership group and age group[ab]

Land input group	Land ownership group		Age group		
			Low age	High age	Total
			(thousand dollars)		
Low land	Low ownership	(1)	103 (23)	68 (8)	94 (31)
		(2)	63 (21)	50 (8)	59 (29)
		(3)	27 (21)	9 (8)	22 (29)
		(4)	5 (21)	0 (8)	4 (29)
	High ownership	(1)	70 (10)	85 (20)	63 (30)
		(2)	26 (9)	50 (20)	42 (29)
		(3)	5 (9)	12 (19)	10 (29)
		(4)	0 (10)	3 (19)	2 (29)
High land	Low ownership	(1)	94 (21)	80 (13)	88 (34)
		(2)	63 (21)	70 (13)	66 (34)
		(3)	17 (21)	8 (12)	14 (33)
		(4)	1 (19)	0 (9)	1 (28)
	High ownership	(1)	152 (12)	80 (19)	108 (31)
		(2)	75 (12)	45 (18)	57 (30)
		(3)	22 (12)	7 (18)	14 (30)
		(4)	9 (8)	4 (18)	5 (26)
Totals		(1)	103 (66)	80 (60)	93 (126)
		(2)	59 (63)	53 (50)	56 (122)
		(3)	19 (62)	10 (58)	15 (120)
		(4)	4 (68)	3 (54)	4 (122)

[a]Interest rates on amount borrowed are as follows: (1) 3 percent; (2) 5 percent; (3) 7 percent; (4) 10 percent.

[b]Data in parentheses are the number of respondents for the specified group, by age, ownership and interest rate.

ing capital because of a large investment in land, or who are limited in working capital because of a desire to engage in larger farm operations, and (2) the older farm operators.

Farm operator members were questioned about their preferences regarding (1) maturity dates and interest rates on securities, and (2) length of revolving period for deferred patronage refunds. Significantly, more than one half of the members interviewed were unwilling to consider investment in securities payable at the discretion of the board, regardless of interest rate. The number of respondents who expressed willingness to consider different forms of securities, and the expected interest rate on each security, varied as follows:

Kind of security	Respondents	Expected interest
Demand note	119	4.1
Ninety day note	125	4.4
Five year note	142	4.4
Ten year note	128	4.4
Payable at discretion of board	75	5.2

It may be noted that the expected interest rate for both a short-term and long-term building note was 4.4 percent.

The simple rate of discount on deferred patronage refunds held in a revolving fund with specified revolving periods was less than one percent.* The average value to members of 500 dollars in deferred patronage refunds,

---

*Respondents were advised that the sale of their patronage refunds at a discount would not impair the operation of the cooperative to lessen the confounding effect of the present economic status of the cooperative.

by specified revolving periods, was as follows:

Revolving period	Respondents	Present dollar value
10 years	148	449
7 years	120	452
5 years	117	466
3 years	109	483
1 year	101	498

The financing limitations of farmer cooperatives may stem as much or more from these preferences of farm members as from the relative rates of returns and benefits from alternative investment opportunities. Rational choices among investment alternatives involve a process of subjective discounting. Hence, farm members, acting in their entrepreneurial capacities, may apply the relevant discount rates to investments in their elevator associations and yet behave rationally.[7]

Sales, Operating Proceeds, and Cash Flows in Cooperative Elevator Associations

The owner-patrons can retain control of their jointly operated activity as long as they maintain two conditions for the organization: (1) receipts in excess of expenditures over the life of the organization, and (2) enough cash to pay all accounts which come due and which would result in bankruptcy of the organization if they were not paid. Both conditions must be satisfied for a going business. Once the cooperative has maintained

---

[7] Gerhard Tintner. The theory of production under non-static conditions. Journal of Political Economy. 50: 645-667. 1942.

itself over some period of time and satisfied its creditors that it will continue as a going business, it will have reached a milestone in its career; this recognition brings status to it and its directors and managers as well as prospects for further expansion.

The question arises when is the cooperative most successful in fulfilling its purposes? It is postulated that the optimum point or level of operation occurs when the net savings per dollar of the patronage are maximized.

The postulate of maximization of unit net savings is discussed by Phillips.[8] Unlike profit maximization in the firm, maximization of the unit net savings on patronage with the cooperative activity may not maximize total net savings on the books of the cooperative. Total net savings are maximized when the marginal net savings equal marginal costs. Net savings per unit of patronage are maximized when the difference between the long-run average cost curve and the long-run average demand curve is the greatest.[9] The optimum size of the cooperative is defined, therefore, by the point at which the unit net savings are maximized. Finally, the optimum combination of resources, at any output level, is the least cost combination of resources.

The liquidity condition is needed to evaluate departures from optimum positions as defined by the maximization of the relevant choice criterion. Similarly, the total decision-making environment must be considered to evaluate the financing needs of the cooperative. Cooperatives

---

[8]Richard Phillips, op. cit.

[9]Ibid.

may operate at uneconomic levels, not because they are unaware of the high costs of operation at low volume, but because expansion and the attendant depletion of liquid assets would make day-to-day operations difficult in face of employees' insistence on being paid periodically, producers' refusal to patronize without payment at competitive prices for the goods delivered, or wholesalers' pressures to reduce their accounts receivable with the cooperative.

Data on the operating and financial condition of cooperative elevator associations are related to the partial framework for analyzing the economic behavior of these cooperatives. The sample of 86 elevators, as well as the smaller samples, i.e., 8 and 32 elevators are analyzed in terms of (1) physical volume of commodities handled, (2) price fluctuations during the post-war period, (3) normal mark-up and realized margins, (4) gross operating proceeds, and (5) net savings and net cash flows. These categories result in certain requirements for financing and they provide additional sources of financing.

Physical volume of commodities handled.

The quantity of sales and purchases of elevator associations involve annual and seasonal variations, which are the result of variations in physical and unit prices among the different commodities handled by the elevator. The variations in physical volume include year-to-year changes in (1) the quantity of grain marketed for farm patrons and (2) the quantity of commodities purchased through the elevator by farm patrons.

The pattern of total grain purchases depends on the percentage distribution of different grains purchased. Available data show that in

1954 62 percent of all grain handled by country elevators in the State was corn, while soybeans, oats and other grains comprised, respectively, 20 percent, 16 percent, and 2 percent of the total grains.[10] It is estimated that the percentage distribution for the cash-grain area, i.e., State economic area 2, was approximately 62 percent, 20 percent and 18 percent, respectively, of corn, soybeans and oats.

The physical volume of grain marketings is affected by the nature of local demand for grain. Local sales of corn and oats by country elevators in Iowa comprised 44 percent and 59 percent respectively, of the bushel volume handled in 1954. The 47 counties in the 4 crop reporting districts that comprise the principal grain producing areas of the State varied in the percentage of each grain sold locally, as follows:[11]

Crop reporting district	Corn	Oats
Northwest (1)	36	49
North Central (2)	21	58
West Central (4)	50	50
Central (5)	38	49

Variations in total grain sales, including farm-to-farm sales, were the greatest during the three-year period, 1947 to 1949 (Table 24). Grain elevators, which can handle the large as well as the small crops may have an even larger variation in grain sales. Hence, there would be an excess of grain merchandising facilities in all but the largest grain crop years.

---

[10]Kenneth R. Farrell. Economic factors affecting the location, size and type of grain storage facilities in the North Central United States, Unpublished research. Ames, Iowa, Iowa Agr. Exp. Sta. 1956

[11]Ibid.

Table 24. Indexes of quantity sold of selected grains, 1946 to 1953 crops, Iowa (1947-49 = 100)[a]

Crop year	Corn	Oats	Soybeans	Total
1946	144	86	111	124
1947	47	86	91	64
1948	172	115	113	148
1949	81	99	96	88
1950	84	100	135	95
1951	78	61	103	77
1952	173	76	119	139
1953	149	49	108	116

[a]Calculated from data on disposition of specified farm crops. U. S. Department of Agriculture. Agricultural Statistics. Washington, D. C. 1948-1954.

Individual elevator associations in North Central Iowa were contacted for information regarding their seasonal pattern of grain purchases and sales. This information, together with the data from a previously cited study[12] and from summary reports of the U. S. Department of Agriculture,[13] provide the bases for the estimated percentage distribution of normal monthly grain purchases in Table 25. It is estimated that 29 percent of corn sales to elevators are transacted in the three months including and following the October harvest, while 44 percent of the oat sales and 48 percent of the soybean sales occur during the immediate post-harvest periods.

[12]Index numbers of normal month-to-month variation in grain receipts at terminal markets were derived using the ratio-to-moving average method. Farrell, op. cit.

[13]U. S. Department of Agriculture. Crops and markets. Washington, D. C. 1949.

Table 25. Estimated percentage distribution of normal monthly grain purchases for selected elevator associations, Iowa

Month	Corn	Oats	Soybeans
July	0	24	0
August	0	11	0
September	0	9	4
October	9	7	35
November	11	5	9
December	9	5	4
January	11	4	8
February	8	4	4
March	7	6	4
April	6	7	8
May	7	8	12
June	7	10	6
July	8	0	4
August	9	0	2
September	8	0	0

Merchandise sales for the elevators in the study may have responded only slightly to the factors that affected the quantity of grain sales. Month-to-month variations in merchandise sales, however, persisted among different commodities. Generally, fertilizer and seed sales occur largely in March, April, and May, while building and fencing materials have relatively large sales during the summer months, as shown in Table 26.* Other commodities have unique seasonal demand patterns, e.g., motor supplies, farm supplies and feed. The additional labor, working capital and physical facilities required to handle the increased seasonal sales and the

*The estimated seasonal patterns of merchandise sales are based on data collected from individual elevators in North Central Iowa, which are included in the larger sample of 86 elevators.

Table 26. Estimated percentage distribution of normal monthly merchandise sales for selected elevator associations, Iowa.

Month	Feed	Farm supplies	Building-fencing materials	Motor supplies	Fertilizer	Seed	Miscellaneous
Jan.	8	3	3	7	1	0	5
Feb.	7	3	2	7	2	0	8
Mar.	10	12	5	8	12	25	7
Apr.	9	7	9	11	22	61	16
May	11	12	13	8	11	14	7
June	10	21	18	10	11	0	2
July	8	13	8	6	0	0	0
Aug.	7	5	8	5	0	0	10
Sept.	8	6	15	11	3	0	8
Oct.	8	5	6	11	4	0	5
Nov.	7	6	8	9	20	0	18
Dec.	7	7	5	7	14	0	14

attendant inventories, provides management with certain problems as well as advantages--the latter including the advantages obtained through diversification.

Price fluctuations during the post-war period, 1946-1954.

Seasonal and certain irregular price changes among grains have affected the level of grain sales and purchases, but these changes are not wholly independent of quantity changes.* The post-war price rise among farm supplies reached a peak in 1951 and 1952, but during the intervening period, 1946 to 1952, price increases made a relatively large contribution to the increased dollar value of sideline sales.

*The two kinds of changes, i.e., physical volume and unit price, tend to compensate each other with the result that variations in the dollar value of grain business per elevator are relatively small.

Changes in grain prices include (1) a year-to-year change and (2) a seasonal change. The former is affected by the quantity of grain placed on the market, as well as other factors in the feed livestock economy, while the latter is affected by the costs of storage and the expectations regarding the next year's grain crop. Farm prices of corn, oats and soybeans varied as much as 57 percent in relation to the 1947-49 base period (Table 27). Peak prices occurred for the 1947 crop, which was a relatively small crop in Iowa. The price stabilization program of the federal government was an additional factor in limiting the amount of variability in farm prices.

Table 27. Indexes of farm prices of selected grains, Iowa, 1946 to 1953 crops (1947-49 = 100)[a]

Crop year	Corn	Oats	Soybeans	Average[b]
1946	97	96	101	101
1947	137	134	128	134
1948	83	86	86	85
1949	80	80	86	81
1950	96	99	100	102
1951	102	108	104	111
1952	95	95	102	102
1953	95	94	105	105

[a]Calculated from data on prices received by farmers from sales of specified crops. U. S. Department of Agriculture. Agricultural statistics. Washington, D. C. 1954.

[b]Average price weighted by bushels sold of each grain.

The normal month-to-month variations in prices received by farmers in Iowa for grains, oats and soybeans are shown in Table 28. Each crop reaches its peak seasonal price one or more months preceding its harvest date. Seasonally low prices occur during the harvest period and again in February, when each commodity experiences a sharp fall in price. The seasonal pattern of prices, obviously, may result in certain grain inventory gains or losses.

Table 28. Index numbers of normal month-to-month variation in grain prices received by farmers, Iowa[a]

Month	Corn	Oats	Soybeans
January	100	111	100
February	92	102	93
March	98	107	102
April	102	105	105
May	103	102	105
June	104	99	106
July	105	91	106
August	105	89	105
September	104	93	93
October	95	95	90
November	92	99	95
December	100	107	100

[a]Percentage ratio of each month to year average as 100 for the post-war years, 1947-1954. U. S. Department of Agriculture. Crops and markets. Washington, D. C. 1949-1955.

Variations in prices paid by farmers in Iowa for selected commodities used in production are limited chiefly to year-to-year changes. The pattern of prices paid for different commodities by farmers in the United States, which is shown in Table 29, may adequately show the pattern pertaining to

Iowa farmers. Generally, the prices paid by Iowa farmers for commodities handled through their grain elevators reached peak levels in 1951 and subsequently declined to the lowest levels for the post-war period, 1947-1954. Sideline merchandising, therefore, involves smaller possibilities of inventory gains and losses than grain merchandising, provided the turnover rate is the same. However, sidelines are stocked in anticipation of sales over a several month period, whereas grain may be shipped to terminal markets within a few days of its receipt, which adds, therefore, to the relative risks attendant with sideline merchandising.

Table 29. Indexes of prices paid by farmers for selected commodities used in production, United States, 1947-1955 (1935-39 = 100)[a]

Year	All commodities	Feed	Motor supplies	Farm supplies	Building-fencing materials	Fertilizer	Seed
1947-49	237	231	140	235	296	143	242
1947	181	236	129	222	277	134	226
1948	202	250	144	236	308	146	263
1949	192	206	146	246	304	150	238
1950	198	210	149	247	312	144	228
1951	220	236	156	264	346	152	232
1952	221	239	151	200	240	153	223
1953	204	216	154	201	241	154	205
1954	203	215	156	196	241	152	192

[a]U. S. Department of Agriculture. Agricultural Research Service. Farm Cost situation. Washington, D. C. March, 1955.

Normal mark-up and realized margins.

Variations in realized gross margins represent a third element that affects the level of operating proceeds from year-to-year. Customary practices in determining the margin per unit of sales differ among commodi-

ties, but two practices are in general use: (1) a percentage mark-up, and (2) an absolute mark-up. The former apply to merchandise, or sidelines, the latter to grains. It is assumed that only year-to-year variations in these margins are important. Paucity of data in this area, however, limits the present analysis to 1955 normal margins.

Normal grain margins for a selected group of elevators included in the sample of 86 elevators ranged from 2.5 to 5.5 cents per bushel (Table 30). The extreme lower and upper values, which involved approximately 10 percent of the cases reported, were excluded from the tabulations.

Table 30. Normal margins per bushel for grains, including lower and upper limits of ninety percent range, North Central Iowa, 1955

Grain group	Ninety percent range		Average margin
	Lower limit	Upper limit	
	(cents per bushel)		
Corn, wholesale	2.5	4.0	3.0
Corn, retail	3.0	5.0	3.5
Oats, wholesale	2.5	4.0	3.0
Oats, retail	3.0	5.0	3.5
Soybeans, wholesale	4.0	5.5	5.0

Normal mark-ups on the principal merchandise groups handled by the elevator associations in 1955 are shown in Table 31. Mark-up practices differed among elevator associations as a result of different competitive situations, e.g., fertilizer, and different composition of the merchandise groups, e.g., petroleum.

Table 31. Normal mark up per dollar of purchases for selected merchandise groups, including lower and upper limits of ninety percent range, North Central Iowa, 1955

Merchandise group	Ninety percent range		Average mark-up
	Lower limit	Upper limit	
	(cents per dollar)		
Feed	10	15	12
Fence and posts	15	25	20
Fertilizer	10	12	10
Hardware	25	33	30
Lumber	25	33	30
Petroleum	15	30	20
Seed	10	15	12
Tile	10	20	15
Coal	15	25	20
Other	20	20	20

Realized margins differ from the normal mark-ups on different commodities because of (1) different inventory practices, and (2) storage losses. Inventory practices vary with commodities, and also, with price and sales expectations. In this study it is necessary to make certain assumptions regarding these two aspects of management.

Gross operating proceeds.

The gross income available to the elevator association for payment of operating expenses and as a source of financing may be shown for (1) a one-year period and (2) a period of several years; the latter may cover an economic cycle, including depression years as well as years of peak prosperity. This study is limited to the post-war period, however, which includes years of relatively large gross operating proceeds per elevator.

Yet, within this period there were wide variations in relative proceeds from different commodity groups.

Average gross operating proceeds per elevator association have climbed steadily upwards in dollar value over the eight marketing periods, 1946 to 1953 (Table 32). Income from handling and storage of government grain, which is included in other income, has increased most rapidly. Patronage refunds earned have declined from the two year period, 1947 to 1949, when wholesale margins on grain and merchandise handled by regional marketing and purchasing associations were at relatively high levels partly because of inventory gains over a period of sharply rising prices.*

Table 32. Indexes of average gross operating proceeds per elevator association, fiscal years ending 1946-47 to 1953-54 (1946-49 =100)

Fiscal year ending	Commodity margins	Patronage refunds earned	Other income	Total
1946-47	107	63	78	99
1947-48	102	113	85	101
1948-49	91	124	137	100
1949-50	91	75	267	105
1950-51	123	45	265	125
1951-52	130	79	274	136
1952-53	118	51	235	119
1953-54	131	51	425	147

Gross operating proceeds from sales of grain and sidelines depend on (1) the practice in determining margins or different commodities, and (2) the physical and dollar volume of sales. Variations in bushel volume of grain sales affect directly the level of gross operating proceeds. Gross

*Analyses of yearly variations are based on the sample of 32 elevator associations

operating proceeds from merchandise sales, however, depend directly upon the dollar volume of sales. Table 33 shows the pattern in dollar sales of grain and merchandise, but a comparison of Tables 24, 27 and 33 is necessary to establish the patterns of dollar sales, physical volume and unit prices that are relevant to the determination of gross operating proceeds.

Table 33. Indexes of average dollar value of sales per elevator association, fiscal year ending 1946-47 to 1953-54 (1946-49 = 100)

Fiscal year ending	Grain sales	Sideline sales	Total
1946-47	106	82	101
1947-48	113	106	111
1948-49	81	112	88
1949-50	61	123	75
1950-51	91	151	104
1951-52	99	164	114
1952-53	91	171	109
1953-54	83	191	107

Finally, a monthly distribution of gross operating proceeds may provide a basis for determining the net cash flows in the cooperative business. The derivation of short-term capital budgets is involved in the linear programming solutions.

Net savings and net cash flows.

Net savings comprise the residual of gross operating proceeds, including service income and patronage refunds earned, after subtracting operating expenses (Appendix). Net savings, on a monthly or annual basis,

may be derived from gross operating proceeds and operating expenses. Net savings, together with external sources of financing, provide the cooperative with additional funds for inventory, physical plant and other capital expansion programs.

The distribution of net savings, as an internal source of financing for the 1953-54 marketing season, are summarized as follows:

Net savings allocation	Percent of total
Patronage refunds	77
Surplus	13
Dividends on stock	2
Income taxes	8
Total	100

The revolving fund is the principal form in which net savings are used in financing the cooperative. Income taxes and dividends on preferred and common stock generally account for about 10 percent of the net savings.

Financing Sources in Cooperative Elevator Associations

The second principal source of financing in the elevator association includes members who are willing to invest in their cooperative, and non-member lenders. The external (or additional) financing sources may be sub-grouped under the following headings: (1) debt financing, i.e., obligations of the elevator association that have a maturity date and penalty for non-compliance with the requirements of the obligation, and (2) member equity, i.e., member shares in the joint activity that provide for an intact capital fund in the cooperative.

The willingness of members to finance their joint activity is a measure of cooperative success. The different parties involved in the business, however, contribute to the organization in return for inducements

that are offered.

The participating entrepreneurs have the inducement of profits which is maximized at the same time their inducement as patrons is maximized. The cooperative form of business organization is unique in this sense.[14] However, when the investment of one of the participating entrepreneurs is large relative to his use of the joint plant, his interest as an investor may dominate his interest as a patron. The primary inducement to the participating entrepreneur who invests in the cooperative may be the profits on his investment rather than the additional profit which accrues to his farm business by patronizing his cooperative.

The inducement of size and growth is also important to the participating entrepreneur. It has been frequently observed that the member who has put cold hard cash into new cooperative facilities is proud of his cooperative and let others know his feelings, particularly those who have accused him of wanting the cooperative to expand. The employees, too, find an incentive for increased participation in an expanding organization, since it offers greater opportunities for prestige and advancement than one that is static or declining.

In equilibrium, the sum of the member and non-member contribution is just adequate to provide for the necessary kinds of inducements to maintain the cooperative activity.* Patrons contribute a minimum amount

---

*The economic conditions for equilibrium for the cooperative and the participating firms have been discussed by Phillips in his doctoral dissertation. The criterion of efficiency, which Phillips follows in his discussion, provides for the use of the given resources of the organization as effectively as possible in light of the organizational objective.

[14]Frank Robotka, Analysis of federal income tax laws. Unpublished research. Ames, Iowa, Iowa Agr. Exp. Sta. 1948.

equivalent to the gross operating proceeds, which supplies the monetary inducements to the employees and the owner-patrons of the cooperative. When these contributions are more than the gross operating expenses, the cooperative can grow and expand; when they are less, it must shrink and ultimately fail.[15]

The historical pattern of the two major categories in financing, i.e., debt financing and equity financing, are discussed in the following sections. The principal inducements, i.e., interest payments and patronage benefits, secure the two kinds of financing funds to operate the cooperative activity.

Debt financing.

Debt financing by cooperative elevator associations increased four-fold during the eight year period, 1946-47 to 1953-54. Short-term loans, e.g., notes payable, increased eight-fold while mortgage loans increased twenty-fold over their average 1946-49 levels, while other current liabilities increased less than two-fold (Appendix).

The 1953-54 structure of current and long-term liabilities of elevator

---

[15]The equilibrium conditions require (1) the least-cost combination of inputs for any given level of outputs and (2) the optimum level of output. The first sub-condition is attained when the marginal productivities of all inputs used in the production of any output are equal; the second is attained when the marginal expenditure for each input equals its marginal productivity. The two conditions are satisfied simultaneously when the ratio of the marginal return to the marginal expenditure is equated for all inputs used in the production of any output. In addition, the second order and total conditions must be satisfied for stable equilibrium. Thus efficiency in the administrative, as well as the economic sense, is a basic value criterion. Simon, op. cit., Phillips, op. cit.

associations, based on the sample of 86 elevators, may be summarized as follows:

Liability group	Percent of total
Notes payable	25
Other current liabilities	42
Mortgage loans	33
Total	100

The elevator associations with above average increase in total assets over the 1950-54 period were above average in the amount of indebtedness.

Equity financing.

Average member equities per elevator association had increased 87 percent above the 1946-49 level by the end of the 1953-54 fiscal years. The dollar value of memberships increased only 16 percent, but allocated patronage refunds and preferred stock increased 99 percent and 95 percent, respectively, during this period, (Appendix).

The pattern of member equities for the 1953-54 fiscal year endings, based on the sample of 86 elevators, is shown summarized below:

Member equity group	Percent of total
Memberships	45
Preferred stock	12
Allocated patronage refunds	58
Surplus	25
Total	100

The pattern of member equities varied by financing situation, with allocated patronage refunds comprising 60 to 65 percent of the total member equities in financing situations Aa, Ab and Bb and 42 percent in financing situation Ba.

The revolving period and the annual allocation from net savings to the revolving fund specify the level of the revolving fund in the static case. Financing situation Ba involves not only the smallest dollar value of allocated patronage refunds, but also the shortest revolving period (Table 35). However, the coefficient of variation was larger for the elevator associations with the lesser amount of expansion, including the elevators in financing situation Ba.

Table 34-35. Average revolving period and coefficient of variation, by financing situation

Item	Financing situation				Average
	Aa	Ab	Ba	Bb	
Revolving period (years)	6.6	5.6	4.5	5.8	5.4
Coefficient of variation (percent)	47	37	53	29	40

FINANCING AND PRODUCTION REQUIREMENTS

The association of farm member patrons, and the joint activity that they own and control, provide the organizational context for the operating and financing practices of the cooperative business. The cooperative form of business organization involves modifications of practices usually associated with the typical agricultural firm. Financing, for example, is a responsibility of the member patrons in their capacity as patrons rather than as investors *per se*. The need for additional sources of financing, however, is not eliminated by the form of organization. The need for financing is handled by the members or their board of directors at the annual business meetings of the cooperative association.

The requirements of the productive services furnished by an elevator plant operated by a cooperative association are essentially the same as for a similar plant operated by a firm. Grain merchandising requires certain grain handling facilities and personnel that may be specified beforehand depending upon the expected level of grain receipts. Sideline merchandising involves capital and labor requirements that may be specified, also, with considerable accuracy. The grain and sidelines handled by the cooperative are essentially the same as the grain and sidelines that would be handled by an elevator firm.

Analytical Models and Procedures for Estimation of Production and Financing Requirements

The sample of 86 elevator cooperatives provided the data for estima-

tion of specified production and financing coefficients. Annual audit reports prepared by the Farmers Grain Dealers Association of Iowa were available for each of the 86 elevators for fiscal years ending July 1, 1953, to June 30, 1954. The use of records prepared by the same group of auditors reduced the need for frequent adjustment of the recorded data to some uniform basis. Major adjustments of data were involved, however, in the case of two groups of elevator associations: (1) elevators handling livestock, and (2) elevators participating in accelerated amortization programs. The gross operating proceeds from handling livestock were included with the other income category, which reduced the dollar value of sales for these associations. Depreciation rates were adjusted to a uniform basis as specified by the schedule of depreciation rates used by the auditors.

Coefficients for specified resource relationships were computed by fitting the survey data to two kinds of statistical models: (1) a model using actual observations, and (2) a model using logarithmic values of the actual observations. The former was used in a limited number of cases; the second was used in all cases, either as the only model or as an alternative to the model with the actual observations in linear or quadratic form. The two kinds of models may be denoted by,

$$R_i = \sum_{j=0}^{n} \alpha_{ij} X_j, \text{ and} \tag{3.1}$$

$$R_i = \prod_{j=0}^{n} X^{\beta_{ij}}, \ (i = 1, \ldots m; \ j = 0, \ldots n), \tag{3.2}$$

where R_i = total quantity of the i^{th} requirement

X_j = total quantity of the j^{th} variable

α_{ij} = units change in the i^{th} requirement associated with a one unit change in the j^{th} variable

β_{ij} = percent change in the i^{th} requirement associated with a one percent change in the j^{th} variable

The least-square method was used in the computation of the coefficients for each requirement relation, R_i. The use of this method gives the best unbiased linear estimates of R_i and, also, of the α's and β's under two specified situations: (1) when there are errors in the variable R_i, and (2) when there are errors in the regression equation.[1] It is recognized that the independent variables may be subject to error and, further, the assumptions of independence, additivity and homogeneity may be violated.

The sample design may provide ambiguous results in the computation of total regression coefficients. Preliminary graphical analyses indicated that the ambiguity would be limited to the assets requirements relations and the net savings relations. These sets of coefficients were derived, therefore, for the elevators in each financing situation, as well as for the total sample of elevators (Appendix). All other requirement relations are specified for the total sample of 86 elevator associations.

Structure of Resource Requirements

The total resource requirements of the cooperative activity may be summarized algebraically using matrix notation. Let $A = [a_{ij}]$, and $X = (x_j)$. The requirement element R_i in R may be obtained from A and X

---

[1]Gerhard Tintner. Econometrics. New York, John Wiley and Sons. 1952. p. 83.

as follows:

$$R_1 \geq a_{11} x_1 + a_{12} x_2 + \dots + a_{1n} x_n \qquad (3.3)$$
$$R_2 \geq a_{21} x_1 + a_{22} x_2 + \dots + a_{2n} x_n$$
$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$
$$R_m \geq a_{m1} x_1 + a_{m2} x_2 + \dots + a_{mn} x_x$$

The column of R 's may be denoted by the columnar matrix R. Hence, for a fixed level of available resources inputs, it is possible to specify that,

$$R \geq A X \qquad (3.4)$$

i.e., the total requirements needed for the merchandising and financing activities must not exceed the available supply of requirements.

The production requirements of each cooperative result from the business volume that must be handled and the peculiarities inherent in each situation. The latter is handled by grouping the elevators by certain specified financing situations. The dollar value of commodity sales and other income, e.g., storage of government grain, are shown by financing situations in Table 36.

Table 36. Average specified total sales, by financing situation, fiscal year ending 1953-54[a]

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(thousand dollars)			
Grain sales	266.1	325.0	446.6	590.8
Sideline sales	97.8	166.0	284.6	365.3
Other income	7.5	12.2	14.7	26.0
Total	371.4	503.2	745.9	982.1

[a]Average values at respective geometric means.

Limitational requirements of sales merchandising activities.

A primary limitation to growth and expansion in the cooperative association is the size of the membership. Preliminary estimates were made of sales potentials for financing situations Aa and Ba, from (1) state,[2] county,[3] and type-of-farming area[4] data on disposition of the annual grain crop and total cash expenditures, and (2) survey data on merchandising relationships among elevators in each financing situation. Estimates of potential new sales for financing situations Aa and Ba are as follows:

Item	Aa	Ba
Grain sales	$53,200	$89,300
Sideline sales	61,600	50,000
Other income	4,300	7,100
Non-member sales	15,400	12,500

Initial supplies of merchandising requirements establish limitations on merchandising activities during the transitional period. These requirements include (1) fixed assets, (2) current assets, (3) operating inputs, including labor, depreciation, and other operating expenses. The supplies of these requirements are specified in Table 37.

---

[2]U. S. Department of Agriculture. Agricultural statistics. Washington, D. C. 1949-1954.

[3]Iowa State Department of Agriculture. Iowa Year book of agriculture. Des Moines, Iowa. The State of Iowa. 1948-1954.

[4]Wylie D. Goodsell, et al. Farm costs and returns, 1954 (with comparisons), commercial family operated farms, by type and location. U. S. Department of Agriculture. Agr. Research Service, Agr. Info. Bul No. 139. 1955.

Table 37. Supply of limitational sales requirements, by financing situation[a]

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(thousand dollars)			
Fixed assets supply[b]				
Grain sales	10.0	16.2	32.1	10.9
Sideline sales[c]	13.9	16.0	40.3	6.7
Other income	14.9	34.1	24.2	37.8
Joint utilization	1.1	16.0	8.0	91.6
Current assets supply[d]				
Grain sales	10.1	12.8	16.9	22.3
Sideline sales	25.2	42.7	73.3	94.1
Joint utilization	15.5	15.5	15.5	15.5
Operating inputs	21.6	31.1	42.9	56.7
Total financing	92.5	155.9	213.9	283.6

[a]Average values at respective geometric means.

[b]Based on data from 86 elevators.

[c]Including non-member sales.

[d]Based on data from 52 elevators.

The fixed assets of the cooperative may be included in a single category provided (1) the individual asset items are perfect complements or perfect substitutes in production, and (2) the individual asset items involve the same financing requirements. The fixed asset requirements are computed from data for the sample of 86 elevators. The first assumption may be violated because of peculiarities of the type-of-farming area, e.g., amount of surplus grain available for export from the local area and the business volume in grain and sidelines, which establish the amount of patronage refunds earned and the amount of investment in regional

cooperatives. However, essentially perfect substitution is likely to exist between several of the different forms of long-term financing that would be available to finance investment in regionals or investment in physical plant and equipment.

Partial regression coefficients were derived for each financing situation to show the percentage change in total fixed assets associated with a one-percent change in specified sales, i.e., grain, sidelines and other income (Appendix). The percentage values are approximated by absolute values at the respective geometric means.* These values show the relatively large fixed asset requirements of the other income category, and also, the relatively large asset requirements for expansion of merchandising and other services at the low volume levels.** The low coefficients for financing situation Bb suggest relatively large unused capacities among elevators in this group.

The current asset structure for the population of elevators may be grouped into the component parts, i.e., cash balance, accounts receivable and inventory, and subsequently the individual parts may be related to variations in the level of specified sales. The relationship between a stock variable, e.g., cash balance, and a flow variable, e.g., grain sales,

---

*Sales requirements may be specified as linear coefficients that show the amount of a limitational requirement utilized per unit, e.g., dollar of sales. These coefficients are valid, however, over a limited range of sales in each financing situation. It is assumed that the allowable range in each program involves a linear relationship between sales and the several requirements.

**Other income includes mainly income from handling and storage of government grain. It is comparable to gross operating proceeds on sales.

however, may be specified according to different unit time periods. In this study, 52 of the 86 elevator associations provided data on average monthly cash balances, accounts receivable and inventory (Appendix). These data are related to the value of annual sales for the fiscal year ending 1953-54.

The labor expense group includes salaries and wages, cost of employee insurance, and the taxes imposed by participation in the federal social security and unemployment compensation programs. Labor expense in an average elevator cooperative comprises two-thirds of the total operating expense, exclusive of depreciation charges and interest expense (Appendix). One-third to one-sixth of the total labor expense was attributed to the manager's salary during the fiscal year ending 1953-54.

Depreciation expense is affected by variations in the age structure of assets. The depreciation rate was 9.0 and 7.1 percent, respectively, for elevators in financing situations Aa and Ba and 5.4 and 6.6 percent, respectively, for elevators in financing situations Ab and Bb (Appendix). The larger proportion of new higher cost construction in financing situations Ab and Bb result in higher depreciation rates for these two categories.

Other operating expenses include (1) rent, (2) repairs, (3) property taxes, (4) insurance, (5) utilities, (6) office and elevator supplies, (7) advertising, and (8) other general expenses. The other expense requirements of the different sales groups are comparable to their labor requirements. Certain economies of size are apparent, however, for the other operating expense group.

The several groups of operating requirements, both fixed and variable,

may be aggregated and analyzed in their entirety. In the short-run, i.e., within a marketing season, the different requirements are relatively fixed in total amount. But from year-to-year, other operating expenses and labor expense may be varied. However, the relationship between sales and the requirement is not perfectly reversible, i.e., expansion may be accomplished more quickly than a contraction of resource inputs.

The joint utilization categories under fixed assets supply and current assets supply, in Table 37, pertain to that part of the total requirements which may be used with equal efficiency in any of the specified production activities. Finally, the operating input category pertains to annual operating expenses, including depreciation but excluding interest payments.

Sales requirements per unit of grain sales are specified in Table 38. Varying levels of unused capacity among the four financing situations account for a wide range in coefficient values. The relatively small fixed assets requirements per dollar of grain sales is consistent with the relatively large supply of this requirement. Unit requirements of current assets, however, are constant among the four financing situations.*

Operating inputs per unit of sales attain a maximum for the level of grain sales specified in financing situation Ba. Similarly, total financing requirements are a maximum at this level of grain sales, but the peculiarities inherent in the financing situation, insofar as they affect the fixed assets coefficient, also affect the total financing coefficient.

---

*The initial supply of current assets, rather than unit requirements at the specified merchandising levels, differ among the financing situation.

Table 38. Limitational sales requirements per dollar of grain sales, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(cents per dollar)			
Fixed assets	3.75	4.97	7.18	1.84
Current assets	3.78	3.78	3.78	3.78
Operating inputs	1.38	1.62	1.63	1.60
Total financing	7.65	8.89	11.10	7.22

Limitational requirements per dollar of sideline sales, listed in Table 39 are four-to-seven-fold greater than in grain merchandising. The pattern of unit requirements of sideline sales, however, is similar to the pattern of grain requirements. The sideline merchandising requirements listed also apply to the non-member sales.

Table 39. Limitational sales requirements per unit of sideline sales, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(cents per dollar)			
Fixed assets	14.23	9.66	14.18	2.72
Current assets	25.75	25.75	25.75	25.75
Operating inputs	9.22	7.85	6.33	6.51
Total financing	40.75	36.06	40.46	29.01

Other income requires only two resource groups--fixed assets and operating inputs. Current asset requirements are negligible and, therefore, are excluded from the linear programming model. The fixed assets and operating input coefficient, however, provide for the largest total unit requirements among the three primary merchandising activities (Table 40).

Table 40. Limitational sales requirements per dollar of other income, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(cents per dollar)			
Fixed assets	198.64	280.29	164.51	145.55
Operating inputs	64.86	63.78	80.56	89.79
Total financing	204.00	285.61	171.31	152.92

Limitational requirements of financing activities.

The limitational requirements of financing activities may be specified in terms of (1) the supply of limitational financing requirements and (2) the quantities of different forms of internal financing associated with unit sales. The supply of financing requirements may be specified according to the two major categories of financing, i.e., debt financing and equity financing, with the former including short-term financing and long-term financing in the form of bank loans and building notes sold to members. It is assumed that the distributions in Table 41 may change over the planning period and hence they pertain only to the financial structures at the beginning of the planning period.

Table 41. Supply of limitational financing requirements, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(thousand dollars)			
Debt financing				
Notes payable	4.4	5.0	8.7	4.8
Accounts payable	5.0	8.4	9.4	18.9
Mortgage loans	4.2	13.7	3.7	15.9
Total	13.6	27.1	21.8	39.6
Equity financing				
Membership	2.3	4.7	15.3	9.4
Preferred stock	3.4	14.0	34.3	27.5
Deferred refunds	51.2	77.7	80.7	152.3
Surplus	22.0	32.4	61.8	54.8
Total	78.9	128.8	192.1	244.0

The financing requirements of each cooperative are related to (1) the structure of assets and operating expenses of the cooperative, and (2) the structure of member preferences. Whether or not financing sources available to the elevator association provide adequate funds to cover the various capital and operating expenditures of the cooperative, an optimum financial structure involves more than adequate amounts of financing. The financial structure must achieve consistency between (1) financing needs, as measured by the net benefits that may be imputed to the required financing, (2) financing costs, and (3) financing preferences of members. An analysis of financing requirements that is related to the production requirements of elevator associations may show the different kinds of financing instruments needed in these associations.

The varying seasonal production requirements of elevator associations may be financed through (a) trade credit, in the form of accounts payable, and (b) bank notes and loans, which may be obtained through an open line of credit, or based on collateral in the form of inventory and other assets. Both sources of financing are included in the current liability accounts.

Current liabilities, as a function of sales, vary widely among the 86 elevator associations included in the study. The proportion of total financing accomplished through current liability accounts, however, tends to vary inversely with the annual volume of sales (Appendix).* The total current liabilities for the average elevator association in each financing situation increases from 9.4 thousand dollars in financing situation Aa to 13.4 thousand dollars in financing situation Ab and 18.1 and 23.7 thousand dollars, respectively, in financing situations Ba and Bb.

The other income category involves the largest amount of current liabilities, per dollar of such income, but again, is not comparable to requirements per dollar of grain or sideline sales. Accrued federal and state income taxes on the net savings allocated to storage income contribute part of the increased liabilities. Other factors that are associated with a larger volume of government grain handled and stored, i.e., generally larger over-all operations, account for an additional part of the increased current liability accounts.

The amount of notes payable and the amount of the line of credit available to the cooperative are inversely related to the amount of cash

---

*Monthly variations in accounts payable, however, were not ascertained.

balances and accounts receivable. Detailed analyses of the current asset and current liability accounts of 52 elevator associations show that average monthly cash balances decrease 6.23 cents for every dollar increase in the amount of the line of credit. Average monthly accounts receivable decrease 10.68 cents for every dollar increase in the amount of notes payable at the end of the fiscal year. Short-term capital needs may be more economically available through line of credit rather than a higher cash balance. However, management and members may have an aversion to short-term indebtedness, which is shown in a willingness to maintain a more strict line of credit, i.e., accounts receivable, with patrons.

The quantity of accounts payable, associated with, or derived from one-dollar of specified sales, are summarized in Table 42. It is assumed that accounts payable provide a cost-less source of financing if these accounts are paid within the contract period that is free of any penalty for delayed payment.

Table 42. Accounts payable per dollar of specified sales, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(cents per dollar)			
Grain sales	0.22	0.25	0.25	0.25
Sideline sales	1.58	3.65	8.25	9.90
Other income	12.34	10.75	12.02	8.94

Long-term financing includes (a) mortgage loans and notes, (b) preferred stock, (c) allocated patronage refunds, (d) surplus, and (e) membership certificates, or common stock purchased as a condition of membership.

Analyses of the financial statements of selected elevator associations with mortgage loan experience show that only 30 percent of the variation in the largest amount of long-term indebtedness, or peak loan, during the 10 year period, 1945-1954, is explained by the following variables: net fixed assets, net current assets, average net savings, and permanent capital, i.e., member equity. Significant relationships occurred between peak loans and (a) average net savings and (b) average fixed assets (Appendix). The amount of the peak loan was inversely related with the former, and directly with the latter. Management factors may further explain variations in the amount of long-term indebtedness.

The amount of preferred stock in the elevator associations analyzed was affected by local and historical conditions and hence it was not amenable to analysis in terms of available data from financial statements. It is postulated, however, that total investment capital available from members, through preferred stock and buildings notes, is 50 dollars per member in financing situations Aa and Ba and 75 dollars per member in financing situations Ab and Bb.*

Allocated patronage refunds are related to the past level of sales, particularly, the past level of net savings. The average annual alloca-

---

*The estimates appear reasonable on the basis of available data regarding membership characteristics and the financing experience of the 32 elevators analyzed.

tions to patronage refunds and the length of the revolving period specify the amount in the revolving fund. The marginal cost of additional patronage refunds must not exceed the marginal net benefits of patronage under an optimum financing plan.

Financing available from surplus funds may be specified in terms of the average annual allocation to the surplus accounts and the average period of these allocations. Surplus must equal at least 25 percent of the value of assets, but not more than 40 percent, as provided by Iowa law. Generally, the allocations to surplus are from net operating proceeds attributed to other income and non-member sales, the latter including primarily sideline sales, e.g., petroleum and lumber.

Allocations to the deferred patronage revolving fund may be determined after payment of income taxes, interest dividends, and allocations to surplus, until the latter has attained the specified legal minimum amount. After that, the surplus account is a residual claimant to net operating proceeds.

The amount of financing available from memberships is specified by the articles of incorporation, i.e., specified membership fees. Membership fees range between 5 and 100 dollars, with a modal value of 10 to 25 dollars.

Finally, collateral requirements of lenders and the financing preferences of members, directors and management, may provide important limitations to the distribution of financing sources between term financing and indebtedness. Banks may require at least 40 to 60 percent of the total financing in the form of equity financing. Members, however, may prefer a higher equity ratio, as indicated in Table 23.

VALUATION OF FINANCING AND MERCHANDISING GROUPS

Market prices are used to assign unit values to inputs and outputs. Different degrees of local competition are implicitly included in the stratification of the elevator population into four financing situations. Moreover, different probabilities are associated with each coefficient that is differentiated by financing situation. It is assumed, however, that the estimated coefficients are known with certainty.

Analytical Models and Procedures for Estimation of Unit Values of Specified Activities

The data used to derive the value coefficients were fitted to a logarithmic model of the form specified in the preceding chapter. The value coefficients were computed at the geometric means for each financing situation. Hence, the relevant statistical model may be denoted by

$$\gamma_j = \beta_{ij} \ (R_i^* / X_j^*), \qquad (4.1)$$

where,

γ_j = the value coefficient for the j^{th} activity,

β_{ij} = percent change in the i^{th} requirement associated with a one unit change in the j^{th} variable

R_i^* = quantity of the i^{th} requirement at its geometric mean

X_j^* = quantity of the j^{th} variable at its geometric mean

In each situation, γ_j and β_{ij} are estimated by c_j and b_{ij}, respectively. Finally, an activity is defined as a distinct and separate sales output

or financing resource.

Optimum levels of business operations are defined in terms of the choice criterion. This criterion involves the maximization of the unit net savings of the association. Unit net savings comprise the difference between unit prices and unit costs for a commodity or a commodity group, i.e., an activity. It may be observed that the most profitable activities for the participating members of the cooperative are those with the highest net realized margins per unit of sales.

Estimated Unit Values of Specified Activities

The unit values of specified activities are listed by the nature of the activity. The sales and financing coefficients are based on multiple regression analyses of (1) gross operating proceeds and net savings of elevators, and (2) net returns of capital inputs on participating farms.

Merchandising activities.

The gross operating proceeds comprise the available net payments to cover operating expenses. The residual proceeds represent the net savings of the cooperative, which are allocated to four major categories, i.e., interest dividends, surplus, income taxes and deferred refunds.

All merchandising activities involve prices at two levels of price transactions: (1) prices at the market level and (2) prices at the farm, or local elevator, level.* The realized margin comprises the difference

---

*It is recognized that the initial settlement between the patron and his cooperative does not represent a price in the conventional sense.

between these two sets of prices. Gross operating proceeds, therefore, comprise the total proceeds of the cooperative business, including patronage refunds earned from other cooperatives, after the initial payment for the goods handled.

Gross operating proceeds per unit of specified sales, or gross margins, are the relevant value coefficients for the transitional merchandising activities. These coefficients are summarized in Table 43. It is evident that grain margins decrease while sideline margins increase with volume of sales. Increased gross operating proceeds are associated with a larger variety of sidelines, particularly lumber and petroleum (Table 31). Hence, it may prove economic for cooperative elevators to operate with smaller margins on grain as means of attracting patronage to make possible expansion into sidelines that offer wider margins and greater opportunities for increased net operating proceeds. Finally, it is necessary to specify the gross operating proceeds of service income as equivalent to the income itself inasmuch as the commodity handled is the service involved in storage and other operations that comprise the other income category.

Table 43. Gross operating proceeds per dollar of specified sales, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(cents per dollar)			
Grain sales	2.80	2.78	2.68	2.44
Sideline sales	14.34	11.50	14.58	16.41
Other income	100.00	100.00	100.00	100.00

The post-transitional, or terminal, activities require additional assets and operating inputs. These additional requirements, however, are variable over the total financing period (Tables 38, 39 and 40). Hence, the unit values of these requirements must be deducted from the relevant unit gross operating proceeds plus patronage refunds earned to obtain the new set of value coefficients, which may be designated as unit net savings, or net operating proceeds per unit of sales. The variation in the pattern of unit net savings according to financing situation is shown in Table 44.

Table 44. Net operating proceeds per dollar of specified sales, by financing situation

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(cents per dollar)			
Grain sales	1.19	0.85	0.69	0.42
Sideline sales	5.12	3.65	8.25	9.90
Other income	35.14	36.22	19.44	10.21

The additional non-member sales activities involve a selling cost of one cent per dollar of sales. Hence, each of the coefficients for non-member sales are one-cent less than the respective coefficient for sideline sales.

Financing activities.

Financing costs, following Jacoby and Weston, comprise (1) price of the capital funds, including the opportunity costs of member equities in deferred refunds and surplus, (2) cost of obtaining and utilizing the funds,

(3) effect of tax liability and (4) flexibility in amount of funds utilized.[1] It is assumed that the costs of obtaining and utilizing the funds are handled adequately within the specified limitations of each cooperative and hence does not involve additional costs. The degree of flexibility in the amount of funds utilized is handled in the requirements section of the linear programming presentation.

Two categories of unit cost coefficients must be ascertained in the valuation of financing resources. (1) Unit costs of interest-bearing certificates, with or without maturity date, are readily ascertained since they comprise (a) the interest charge and (b) the associated income tax claims, if any. (2) Unit costs of non-interest bearing forms of financing, however, are less easily ascertained since the relevant unit costs are the alternative opportunity costs of the capital funds of the participating members, which are tied-up in the cooperative. In this analysis, the assigned unit values approximate the true values, but they show the financing implications of any specified structure of financing costs.

The interest-bearing certificates include, (1) short-term bank notes, (2) long-term bank notes, (3) building notes purchased by members, and (4) preferred stock. These categories, including accounts payable, may

---

[1] Factors influencing management directly are (1) cost factors, (2) qualitative factors in fund supplied, (3) inherent risk factors, (4) factors influencing managements' evaluation of risk, and (5) factors affecting management's power of action. Factors influencing management indirectly are (1) characteristics of the firm and (2) financial standards. The authors propose this classification as a series of hypotheses for testing by empirical research. Neil H. Jacoby and J. Fred Weston. Factors influencing managerial decisions in determining forms of business financing: an exploratory study. In Conference on Research in Business Finance. New York, Universities-National Bureau, National Bureau of Economic Research. 1952.

be described briefly in terms of financing cost considerations.

Accounts payable. The accounts payable group include accounts payable to (1) patrons, (2) wholesalers, (3) employees, and (4) government units. Payments on grain handled for patrons may be withheld and used as a source of short-term financing without explicit expense to the cooperative (although the member patrons forego the opportunity cost on the withheld payment). Trade accounts, however, may involve a loss of discount on unpaid accounts, which may constitute an important extra charge to the cooperative that is short on available cash. It is assumed, however, that each cooperative will maintain a specified level of accounts payable as defined by the volume of sales, without additional cost to the cooperative and its membership.

Bank notes and loans. Notes and loans generally constitute the most economical form of financing on a cost basis. The amount of funds is limited, however, by the collateral available as security and the financial position of the cooperative. It is estimated that banks charge 5 and 5½ percent interest, respectively, on long-term and short-term notes. A survey of 52 elevator associations during March, 1955, showed a relatively uniform interest charge for a particular kind of loan, which provides a basis for the estimated interest charge applicable to each of the four groups of elevators in the study. Furthermore, it is postulated that bank requirements and member preferences specify an equity ratio of 0.6 in financing situation Aa and Ab and 0.4 in financing situations Ba and Bb. The use of the 0.4 equity ratio for financing situations Ba and Bb shows the effects on financial organization of a lower than average equity ratio. Farmers indicated in a recent survey, that they considered safe a mean

equity ratio of 0.60.[2]

Building notes. Five year, 4½ percent building notes would provide a relatively economical source of financing to supplement bank notes and loans. The findings of the member survey suggest that the 4½ percent rate may prove more successful than the usual 4 percent rate, although the additional interest cost is relatively small. The cost of these funds, however, may exceed the cost of bank loans and notes as a result of the cost of obtaining and utilizing these funds, e.g., promotion and assembly costs. It is assumed that these additional costs would be negligible.

Preferred stock. Generally preferred stock is issued with a 5 percent interest rate, but no maturity date or cumulation of unpaid dividends. An added tax liability is incurred by preferred stock, however, and it also involves the costs of promotion and assembly. It is assumed that the promotion and assembly costs are negligible. The federal and state tax liability may be computed on the basis of less than 10,000 dollars corporate profits. The total unit financing costs amount to 7.1 percent of the principal.

The non-interest bearing forms of financing include (1) membership certificates, (2) deferred refunds, and (3) surplus. Inasmuch as the membership is fixed in each financing situation, membership certificates would not provide an additional source of financing and they would not incur additional financing costs.

---

[2]R. J. Hildreth. Farmers' investment decisions in relation to time and uncertainty. Unpublished Ph. D. Thesis. Ames, Iowa State College Library. 1954. p. 128.

Deferred refunds. Deferred patronage refunds, when placed on a revolving basis, comprise the revolving fund of the cooperative.* The promotion and assembly cost is nominal and the member carries the tax liability, but the amount of financing is limited by the amount of net savings. Member opportunity costs are the only important costs involved in revolving fund financing.

The opportunity costs of deferred refunds, i.e., revolving fund, may require a procedure as follows: (1) ascertain the investment preference of the membership in terms of the rate of return on members' investment in the cooperative that is equivalent to a specified rate of return on investments; (2) ascertain the distribution of member farms according to the rate of return on capital invested in these farms. The field survey of farm members provides a basis for an estimate of the discount rate on investment in the cooperative as compared to the members' farms. It is postulated, on the basis of data in Tables 21 and 22, that the discount rate for the two financing situations with the linear programming application, i.e., financing situations Aa and Ba, that the discount rate is 160 percent and 200 percent, respectively. It is postulated further, using data for farms in northern Iowa,[3] that the net return on capital investment in member farms is 9 percent and 3 percent, respectively, in financing situations Aa and Ba. The opportunity costs of deferred refunds

---

*Some cooperatives have several revolving funds, and may even, in a limited sense, revolve their common stock. But the currently effective state law pertaining to agricultural cooperatives explicitly provides for revolving only the deferred patronage refunds.

[3]Earl O. Heady and Russell Shaw. Resource returns and productivity coefficients in selected farming areas of Iowa, Montana and Alabama. Ames, Iowa, Iowa Agr. Exp. Sta. Bul. 425. 1955.

invested in the cooperative, therefore, are 14.5 percent and 6.0 percent, respectively, in the two financing situations.*

Surplus. Financing by surplus involves the same costs as revolving funds financing, except that a large percentage of the surplus funds result from non-member patronage; in the latter case, surplus financing is a more economical form of financing for the association. It is assumed that all surplus funds are obtained from (1) other income, and (2) non-member sales. Hence, these funds represent a costless source of funds to the cooperative association.

*The manager and directors of a cooperative may engage in a similar reasoning process that involves estimates of relative returns on capital in the cooperative on participating farms.

FINANCIAL AND MERCHANDISING PROGRAMMING

Programming of financing and merchandising activities in a cooperative elevator association may be accomplished within a two-fold framework: (1) the economic theory of the firm, modified to allow for the unique behavior of participating member patrons in a cooperative and including the economics of vertical integration, provides the economic logic to prepare certain basic data; (2) the methods of mathematical programming make possible the application of the basic data to problems of financial management and planning in the cooperative association. The marginal analysis of classical economics is supplemented by modern mathematics to achieve useful research results that may have wide application.

Logical Bases of Financial Planning in the Cooperative Association

The economic conditions for optimality in financing cooperatives have been described in a previous study.[1] Briefly, the optimum financial plan is one that allows the participating members to maximize the net benefits of membership as a function of the expected withdrawal stream for the joint activity. The optimum structure depends, however, not only upon the factors that add to the stock of cash in the cooperative but also upon the preference of the participating entrepreneurs in relation to the amount and time pattern of withdrawals. It is necessary, therefore, to consider the decision-making process among the members in the cooperative association.

---

[1] Maki, op. cit.

The decision-making framework for this study follows Hurwicz[2]. It is postulated that members of a cooperative participate in the joint activity to maximize the net benefits, or utility, of money withdrawals from the cooperative.*

The decision-making environment includes (1) factors that are known at the time of the decision, e.g., initial assets of members and of the cooperative activity, (2) unknown factors that must be predicted, e.g., future prices, and (3) factors that change according to the decisions made by the members and the manager, e.g., expansion of a specific line of merchandising in the cooperative. These factors provide for choice, within limits, of the production program and the prospective withdrawal stream that maximizes the utility of the participating entrepreneurs. However, the decisions relating to the joint activity have the added qualification that they are made mutually with the joint activity as an integral part of each participating firm.** The relevant choice decisions are those affecting the size and time pattern of the expected withdrawal stream for

---

*The postulate of utility maximization is based on several assumptions: (1) that the participating entrepreneurs' utility is based on the prospective withdrawal stream; (2) that the participating entrepreneurs are able to form some expectations with regard to factors and agents of production; (3) that the participating entrepreneurs act rationally to maximize their individual utilities; and (4) that the participating entrepreneurs do not save within their households. Participating firms, however, may maximize their utilities through other means than the net savings withdrawn from the cooperative.

**The participating firms and not the cooperative maximizes the expected withdrawal stream.

[2]L. Hurwicz. Theory of the firm and investment. Econometrica. 14:109-136. 1946.

the joint activity. The member patrons of the cooperative, therefore, may select one of several possible production plans and financing plans because of their particular appraisal of future conditions and their particular preference systems insofar as members make real decisions regarding the operating and financial policies of the cooperative.

Nature of investment decisions.

The members have a choice as to the size and time pattern of the money withdrawal stream from the stock of cash in the cooperative. If they have a time preference toward the present, they will withdraw currently a relatively large amount of the stock of cash. If they have a time preference towards the future, they will invest more of the funds in the cooperative and as a result increase their prospective withdrawals. They may also prefer to borrow currently to supplement the funds obtained from net savings. Finally, they may disinvest in securities to add more to the available funds for investment in the cooperative itself.

The investment may result in improved services or increased net savings to members. The investment also may provide the additional inducements of size and growth, or these may be the primary inducements for the investment.[3]

The investment decisions differ from one association to the next because of the underlying conditions. These conditions can be grouped according to some logical basis so that recommendations may be generalized.

---

[3]Simon refers to these inducements as "conservation" values. These values also may be important to the more mobile employees. Simon, op. cit.

First, the position of the cooperative in its growth cycle affects its financing situation. Two criteria were specified to define the growth stage: (1) the size of the cooperative and (2) the rate of growth of the cooperative. The first is measured by the average net savings of the cooperative over a four-year period; the second, by the change in total assets over the same period.

Several different price situations may be specified to provide for financing situations at different stages in the economic cycle. However, only the 1953-54 price situation is used in this study. Finally, within each association a certain pattern of membership characteristics is specified, including (1) capital position of the members, as measured by the productivity of capital in the individual farm, and (2) participation of the members in the cooperative, as measured by attendance at the annual meetings, patronage and attitudes relating to participation in the cooperative.

The two-way classification may have any number of levels for each classification, but for the purpose of a first approximation, two levels are specified for each situation. Hence, there are four distinct financing situations. Four sets of relations specified by the analytical model are required. A particular cooperative association may be compared with the four different financing situations; the situation which best describes the financing problem in that cooperative would be selected as an approximation of the true situation and the set of relationships which apply to that situation may be used to obtain an optimum financing plan.*

---

*An alternative procedure would involve the specification of a complete decision-making environment. Different financing situations would have different values assigned to the relevant factors.

Investment, growth and expansion of merchandising services.

A formidable obstacle in investment theory, which is applicable to this study, is the matter of uncertainty and expectations; this is concomittant with the problem of growth. Investment theory is particularly dependent upon a formulation of some ordering of consequences. The formulation problem is handled in several ways. Fisher,[4] Hicks,[5] Lange,[6] Steindl,[7] and Friedman and Savage,[8] hold that uncertainty is described in terms of probability distributions. Thus it is possible to develop a single distribution of prices by compounding probabilities. Hart[9] has criticized this procedure because of the irreversibility of the process and the loss of relevant information.

A non-probabilistic school, including Knight[10] and Shackle,[11] argue

---

[4]Irving Fisher. The theory of interest. New York, The Macmillan Company. 1930.

[5]J. R. Hicks. Value and capital. Second edition. Oxford, The Clarendon Press. 1946.

[6]Oskar Lange. Price flexibility and employment. Bloomington, Ind., Principia Press, Inc. 1952.

[7]J. Steindl. Capitalist enterprise and risk. Oxford Economic Papers, 7:21-45. 1945.

[8]Milton Friedman and L. J. Savage. The utility analysis of choices involving risks. Journal of Political Economy. 66:279-304. 1948.

[9]Albert Gailord Hart. Risk, uncertainty and unprofitability of compounding probabilities. pp. 110-118 in Oscar Lange, et al. (eds). Studies in mathematical economics and econometrics. Chicago, University of Chicago Press. 1942.

[10]Frank Knight. Risk, uncertainty and profit. New York, Houghton Mifflin Co. 1921.

[11]G. L. Shackle. Expectations in economics. Cambridge, Cambridge University Press. 1949.

that decision-making is a unique process and, therefore, lacking in statistical verification. It is recognized, however, that past experience frequently serves as a basis for predicting success in regard to similar future situations, even though these situations are unique in themselves.[12]

Empirical studies by Gainer and Brownlee,[13] D. B. Williams,[14] W. F. Williams,[15] and Heady and Kaldor,[16] give some support to the view that farmers formulate a probability distribution of prices. Katona's and Morgan's[17] study of the investment decisions of Michigan manufacturers, Gort's[18] study of electric utility firms, and the studies by Heller[19] and Meade and Andrews,[20] however, fail to suggest a consistent theory of

---

[12] R. S. Weckstein. On the use of the theory of probability in economics. Review of Economic Studies. 20: 191-198. 1952-53.

[13] M. Gainer and O. H. Brownlee. Farmers' price expectations and the rate of uncertainty in farm planning. Journal of Farm Economics. 31: 266-275. 1949.

[14] D. B. Williams. Price expectations and reactions to uncertainty. Journal of Farm Economics. 33: 20-39. 1951.

[15] W. F. Williams. An empirical study of price expectations and reactions to uncertainty. Journal of Farm Economics. 35: 355-370. 1953.

[16] Earl O. Heady and Donald R. Kaldor. Expectations and errors in forecasting agricultural prices. Journal of Political Economy. 62: 34-47. 1954.

[17] George Katona and James N. Morgan. The quantitative study of factors determining business decisions. Quarterly Journal of Economics. 66: 67-90. 1952.

[18] Michael Gort. The planning of investment: a study of capital budgeting in the electric power industry, I and II. Journal of Business. 24: 79-96 and 181-203. 1951.

[19] Walter W. Heller. The anatomy of investment decisions. Harvard Business Review. 29: 95-103. 1951.

[20] J. E. Meade and P. W. S. Andrews. Summary of replies to questions on effects of interest rates. Oxford Economic Papers. 1: 14-31. 1938.

expectations and formulation of investment decisions for the business firm.

Hurwicz postulates the ability of entrepreneurs to form some expectations, whether correct or not, i.e., subjective probability.[21] The postulate of utility maximization allows for the reaction of the different psychological make-ups to the probability distributions of anticipated events. In this way, an entrepreneur can select that investment plan, or stream of prospective money withdrawals, which he most prefers. It is assumed, following Hurwicz, that anticipated prices, and other factors which are unknown but can be predicted, have a probability distribution described by a single value, i.e., the expected value. The different preferences of entrepreneurs come into play in choosing from among several investment plans that plan which best satisfies these preferences.

Investment in the joint activity involves aspects of the entrepreneur's preference structure which become particularly important in terms of participation in the joint activity, namely, the investment preference and financing preference of the participating entrepreneur acting jointly with other members of the cooperative association. The entrepreneur must formulate expectations regarding the joint activity and the action of other members, insofar as they affect the joint activity, as a basis for rational decision-making in the cooperative association. Financing decisions, also, are based upon the assumption of subjective predictability and the ability to formulate expectations.

Each investment situation, or financing situation, has a unique set of conditions affecting growth in the cooperative. Investment decisions

---

[21] Hurwicz, op. cit.

must be related, therefore, to the environment of which they are a part in order to evaluate differences that exist between an optimum set of investment decisions for given situations and the decisions which are actually made.

Application of Linear Programming to Financial Planning in Cooperative Associations

Linear programming offers an approach to the solution of the long-run production-investment-financing problem complex. Approximately optimal levels of activity for capital budgeting and financial planning purposes may be worked out from a static model. The limitations of the model and technique, however, present certain obvious difficulties in the solution of the long-run problem complex.

The problem of growth and the problem of information are two aspects of financial planning to which this chapter is addressed. The problem of growth in the cooperative association is handled by use of a transitional production and financial program that is an integral part of the long-run program. The problem of information is handled in two ways: (1) by use of the sequence of plans suggested above, and (2) by use of certain easily ascertained variables as estimates of relevant cost and income relationships.

Estimates of the level of fixed inputs that are available during the transitional period may involve a certain element of prediction insofar as previously scheduled changes in these inputs are in process. Finally, estimates of the available financing among members in the transitional and post-transitional periods must depend on previous experience with

solicitation of member participation in financing. Errors in these estimates for the transitional period may be compensated in subsequent estimates. The short one year transitional period, moreover, allows for a relatively high degree of accuracy in prediction based on the previous forecast experience.

The seasonal pattern of merchandising in the cooperative association provides for a forecasting procedure that has a series of forecast target dates corresponding to the merchandising pattern. Peak sales occur near the end of the calendar year for the association engaged primarily in grain merchandising. Sideline merchandising may result in a secondary peak approximately six months earlier. Modighani and Hohn have demonstrated that the optimum production schedule for each interval of the entire planning horizon is generally identical with the optimum plan for the entire planning period.[22] The relevant expectation and planning horizon for financial programming, also, will tend to cover a full seasonal cycle, except when the physical plant and labor force increase rapidly. Only limited information for subsequent intervals of the entire planning horizon is necessary.[23]

The paucity of adequate cost and income data for the cooperative association presents a serious limitation to a general acceptance of capital budgeting and financial planning procedures. This difficulty may be overcome to some extent with the use of more readily obtainable variables

---

[22]F. Modighani and F. E. Hohn. Production planning over time and nature of the expectation and planning horizon. Econometrica. 23: 46-66. 1955.

[23]Ibid. p. 64.

as estimates of the relevant cost and revenue relationships. Charnes, Cooper and Mellon suggest the use of cost surrogates, e.g., labor hours in place of the unknown total costs that are relevant to certain decision functions.[24] Specific quantitative information is necessary only at the subhorizons, or the end of the transitional periods. In addition to labor hours, an index of construction costs, and an index of financing costs may be used in the linear programming solution.

Linear programming problem.

The primary linear programming problem may be stated as follows: With a prescribed level of sales for each merchandising department and a prescribed (1) lower limit of unit return for each department and (2) upper limit of unit cost for each process, what level of each department or process should be attained in order to maximize the total net savings of the cooperative? Two related problems of linear programming are involved, the production organization problem and the resource valuation problem. The fundamental existence theorem for the dual problems provides that feasible solutions of either problem exist if and only if feasible solutions of the other problem exist.[25]

In this discussion,

R_{it} = units of i^{th} requirement in time period t (5.1)

---

[24] A. Charnes, W. W. Cooper and B. Mellon. A model for optimizing production by reference to cost surrogates. Econometrica. 23:307-323. 1955.

[25] A. Charnes, W. W. Cooper, and A. Henderson. An introduction to linear programming. John Wiley and Sons, Inc. New York. 1953.

c_{jt} = unit return or cost of the j^{th} activity* in time period t

a_{ijt} = units of i^{th} requirement in one unit of the j^{th} activity in time period t

x_{jt} = units of j^{th} activity in time period t

The level of the j^{th} activity, x_j, must be determined so as to satisfy the conditions,

$$x_{jt} \geq 0 \tag{5.2}$$

$$\sum_j a_{ijt} x_{jt} \leq R_{it} \tag{5.3}$$

$$\sum_j c_{ijt} x_{jt} = \text{maximum} \tag{5.4}$$

The present value of the program, which covers a five year period, may be discounted so that

$$v = \sum_j \sum_t \frac{x_{jt} c_{jt}}{(1+r)^t}, \quad (t = 0, 1, 2, 3, 4, 5), \tag{5.5}$$

where r is the effective rate of interest, it may be assumed that all expenses for a given year are made January 1 and that all income for a given year is received on December 31. The discounted value of the five year program will be maximized as a condition of optimality.

Merchandising matrix.

The merchandising matrix consists of four merchandising activities. Grain merchandising is the initial marketing function performed by a grain elevator. Sideline merchandising, e.g., feeds, is an additional activity

---

*Hereinafter the term activity is used synonymously with merchandising department, financing group, or capital expenditures group.

that fits into the seasonal pattern of merchandising, and to a limited extent, without additional fixed outlays. Growth in membership and services demanded may result, eventually, in an expansion of sideline merchandising, e.g., oil and lumber, that involves additional capital outlays and operating expenses. It is assumed, however, that both types of sideline merchandising are competitive with grain merchandising. Finally, the cooperative may provide custom services, e.g., feed mixing, and it may participate in the government storage program. These additional services involve relatively large capital outlays in specialized equipment and storage facilities. Since each merchandising function is treated as a separate activity, these activities may be defined as follows:

x_1 = dollar sales of grain

x_2 = dollar sales of sidelines

x_3 = dollar sales of storage and other services

The membership may decide to solicit non-member patronage to realize some economies of size in each department. Since non-members would not contribute to financing in the same way as members, the non-member business may be considered as a separate activity defined as follows:

x_4 = dollar sales of sidelines to non-members.*

The long-range production program covers a five-year period, or four years beyond the transitional one-year period. During this period additional available funds make possible expansion of the merchandising and

---

*Non-member sales in excess of the nominal amount included with member sales.

non-member activities. These additional post-transitional activities may be defined as follows:

x_5 = additional dollar sales of grain after the transitional period

x_6 = additional dollar sales of sidelines after the transitional period

x_7 = additional dollar sales of storage and other services after the transitional period

x_8 = additional dollar sales of sidelines to non-members after the transitional period

The production activities are specified for several different financing situations. The net unit return, production coefficients, and available resources vary in each situation.*

Financing matrix.

The financing matrix is in two parts--the transitional period relates to immediately available financing methods while the post-transitional period relates to financing methods that are dependent on cumulated allocations from net savings and increases in different forms of collateral. The transitional financing activities include six different methods of financing, each with a unique set of total costs and restrictions. The short-term financing through notes payable to the local bank or Omaha Bank for Cooperatives, is limited to seasonal financing, e.g., investing and accounts receivable. The medium and long-term financing through banks have certain collateral requirements and are used for financing physical

---

*Qualitative factors may be handled by use of several programming situations. Measurable quantities would allow the use of a single program.

facilities, although they may be used also to refinance other assets. Building notes purchased by members are assumed to bear four percent interest and are payable in five years. Preferred stock issued by the cooperative is non-accumulating with no due date and bears five percent interest. Deferred patronage refunds are related to patronage and are paid in cash after a certain number of years in the revolving fund. Surplus includes allocations from net savings on both member and non-member business, but generally only non-member business. The relevant costs of the latter two forms of financing are the member opportunity costs on each member's share of each form of financing. The six unique methods of financing represent six financing activities described as follows:

x_9 = total dollar financing from short-term bank notes

x_{10} = total dollar financing from long-term bank notes

x_{11} = total dollar financing from building notes purchased by members

x_{12} = total dollar financing from preferred stock purchased by members

x_{13} = total dollar financing from deferred patronage refunds

x_{14} = total dollar financing from surplus

The post transitional financing activities include the additional amounts of each form of financing that are available over the second, third, fourth and fifth years. The cost as well as the availability of each form of financing differs from the transitional period and thus they are denoted as six additional activities as follows:

x_{15} = additional total dollar financing from short-term bank notes after the transitional period

x_{16} = additional total dollar financing from long-term bank notes

after the transitional period

x_{17} = additional total dollar financing from building notes purchased by members after the transitional period.

x_{18} = additional total dollar financing from preferred stock purchased by members after the transitional period

x_{19} = additional total financing from deferred patronage refunds after the transitional period

x_{20} = additional total financing from surplus after the transitional period

Requirements and restrictions.

The two sets of restraints relate input and financing limitations in each of the two time periods to the production-financing matrix. Limitations of personnel, physical facilities, total capital funds and membership are effective during the transitional period. Membership, and in the long-run the number of farm operators, limits the size of the cooperative in subsequent years. Finally, the financing limitations specify the collateral and other requirements of the several forms of financing.

Limitational requirements of personnel and complementary inputs for the transitional period may be denoted by

$$\sum_j a_{1j} x_j \leq R_1 \qquad (5.6)$$

$$\sum_j a_{2j} x_j \leq R_2 \qquad (5.7)$$

where, R_1 = supply of personnel and complementary requirements for April (peak sideline sales).

R_2 = supply of personnel and complementary requirements for October (peak grain sales)

Fixed assets supply and requirements may be denoted by

$$\sum_j a_{3j} x_j \leq R_3 \qquad (5.8)$$

$$\sum_j a_{4j} x_j \leq R_4 \qquad (5.9)$$

$$\sum_j a_{5j} x_j \leq R_5 \qquad (5.10)$$

where, R_3 = supply of fixed assets available for grain merchandising during the transitional period

R_4 = supply of fixed assets available for sideline merchandising during the transitional period

R_5 = supply of fixed assets available for services and other income

The total capital limitation

$$\sum_j a_{6j} x_j \geq R_6 \qquad (5.11)$$

where, R_6 = supply of financing available for merchandising activities, pertains to the average monthly level of short-term and long-term financing to cover the asset and operating requirements of the cooperative.

The maximum levels of sales may be denoted by

$$\sum_j a_{7j} x_j \leq R_7 \qquad (5.12)$$

$$\sum_j a_{8j} x_j \leq R_8 \qquad (5.13)$$

$$\sum_j a_{9j} x_j \leq R_9 \qquad (5.14)$$

$$\sum_j a_{10j} x_j \leq R_{10} \qquad (5.15)$$

where, R_7 = maximum level of grain sales

R_8 = maximum level of sideline sales

R_9 = maximum level of other income

R_{10} = maximum level of non-member sales

The next six restrictions pertain to the availability of interest bearing and non-interest bearing member financing. During the transitional period, the maximum total amount of preferred stock and building notes held by members is related to the productivity of capital on member farms, the financing and investment preferences of members, the prospective return on the stocks and notes purchased from the cooperative, and the total membership. The maximum total amount in the revolving fund in the form of deferred patronage refunds and also the total amount in surplus and reserves are similarly a part of the initial conditions in the cooperative. Finally, these three restrictions may be redefined for the post-transitional period in terms of changes in the relevant initial conditions. The six restrictions, therefore, may be handled by three kinds of limitations, i.e., financing limitations, institutional limitations, and productivity limitations.

The supply of financing may be specified as follows:

$$\sum_j a_{11j} x_j \leq R_{11} \qquad (5.16)$$

$$\sum_j a_{12j} x_j \leq R_{12} \qquad (5.17)$$

$$\sum_j a_{13j} x_j \leq R_{13} \qquad (5.18)$$

$$\sum_j a_{14j} x_j \leq R_{14} \tag{5.19}$$

where, R_{11} = initial supply of financing mortgage loans, i.e., long-term bank notes and building notes

R_{12} = initial supply of financing from preferred stock

R_{13} = initial supply of financing from deferred refunds

R_{14} = initial supply of financing from surplus

Institutional limitations may be specified that provide for certain summary ratios as measures of financial soundness. A debt-asset ratio and a surplus ratio, which pertain to minimum relative levels of member equity and surplus, may be denoted by

$$\sum_j a_{15j} x_j \geq 0 \tag{5.20}$$

$$\sum_j a_{16j} x_j \geq 0 \tag{5.21}$$

Equations (5.20) and (5.21) specify, therefore, that the member equity and surplus must exceed certain levels that are a function of the total assets of the cooperative.

The marginal productivity principle provides for the maximization of a choice criterion, e.g., profits, when marginal revenue equals marginal cost. The optimum level of resource allocation between the joint plant and the participating firms, according to the marginal productivity principle may be denoted as follows:

$$\sum_j a_{17j} x_j \leq 0 \tag{5.22}$$

where the limitations may be interpreted in the same way as in equations (5.20) and (5.21).

The limitation on financing through member purchases of investment securities may be denoted by

$$\sum_j a_{18j} x_j \leq R_{18} \tag{5.23}$$

where, R_{18} = total anticipated supply of investment among the members of the association.

Finally, expansion of the cooperative facilities during the planning period require additional financing. In fact, the amount of expansion cannot exceed the amount of additional financing available during a specified period, which may be stipulated as the post-transitional period, i.e., the years following the transitional period, in the financial plan. The expansion limitation, therefore, may be denoted by

$$\sum_j a_{19j} x_j \geq 0 \tag{5.24}$$

where the limitation may be interpreted again in the same way as in equations (5.20) and (5.21)

Summary Matrix and Programming Operations

The application of the linear programming technique to financial planning in an elevator cooperative may be illustrated in matrix notation.[26] Let

$$A = (P_1, P_2 \cdots P_n) \text{ and} \tag{5.25}$$

$$P_j = (a_{1j}, a_{2j} \cdots a_{nj}), \text{ a column vector,} \tag{5.26}$$

---

[26]Robert Dorfman. Application of linear programming to the theory of the firm. Berkeley, University of California Press. 1951. pp. 24-27.

where, a_{ij} = amount of the i^{th} requirement in the j^{th} activity

The n activities may be denoted by the vector,

$$X = (x_1, x_2 \cdots x_n) \tag{5.27}$$

where, x_j = level, or intensity of the j^{th} activity

The available quantity of each requirement may be expressed by the vector

$$R = (R_1, R_2 \cdots R_m) \tag{5.28}$$

where, R_i = amount available of the i^{th} requirement

The total utilization of each requirement must not exceed the quantity of that requirement, i.e., algebraically,

$$\begin{aligned} a_{11} x_1 + a_{12} x_2 + \cdots + a_{1n} x_n &\leq R_1 \\ a_{21} x_2 + a_{22} x_2 + \cdots + a_{2n} x_n &\leq R_2 \\ \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots & \\ a_{m1} x_2 + a_{m2} x_x + \cdots + a_{mn} x_n &\leq R_m \end{aligned} \tag{5.29}$$

The solution of the linear programming problem is simplified by the use of certain slack vectors that transform the linear inequalities in equation (5.29) into linear equalities. These vectors, which are handled in the same way as the activities $x_1 \cdots x_n$, may be included in the new matrix,

$$B = (P_1 P_2 \cdots P_n + m) = (A\ W), \tag{5.30}$$

where W is the disposal matrix, i.e., slack vectors of m rows and columns. The matrix B may also be expressed algebraically as follows:

$$\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} & 1 & 0 & \cdots & 0 \\ a_{21} & a_{22} & \cdots & a_{2n} & 0 & 1 & \cdots & 0 \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} & 0 & 0 & \cdots & 1 \end{pmatrix} = (A\ W) \tag{5.31}$$

Now

$$B X \leqq R, \text{ but} \qquad (5.32)$$

$$X \geqq 0$$

i.e., no activity can be carried at a negative level in the solution that maximizes the net savings relation.

The net savings relation may be denoted by

$$S = c_1 x_1 + c_2 x_2 + \dots + c_n x_n, \qquad (5.33)$$

where c_j = unit value of the j^{th} activity.

Simplex procedure.

The simplex method of linear programming is employed in this study. Graphical and descriptive presentations of linear programming operations may be found in the articles by Dorfman[27] and Boles[28] and in the research applications by Bowlen,[29] Heady and Gilson,[30] McKee,[31] and Swanson.[32] Inasmuch

---

[27]Robert Dorfman. "Mathematical" or "linear" programming: a non-mathematical exposition. The American Economic Review. 63: 797-825. 1953.

[28]J. N. Boles. Linear programming and farm management analysis. Journal of Farm Economics. 37: 1-24. 1955.

[29]Bernard Bowlen. Optimum combinations of competitive labor at particular locations. Ames, Iowa Agr. Exp. Sta. Bul. 426. 1955.

[30]Earl O. Heady and J. C. Gilson. Optimum combinations of livestock enterprises and management practices on farms including supplementary dairy and poultry enterprises. Ames, Iowa Agr. Exp. Sta. Bul. 437. 1956.

[31]Dean McKee. Optimum allocation of resources between pasture improvement and other opportunities on Southern Iowa farms. Ames, Iowa Agr. Exp. Sta. Bul. 435. 1956.

[32]Earl R. Swanson. Integrating coop and livestock activities in the farm management activity analysis. Journal of Farm Economics. 37: 1249-1258. 1955.

as numerous discussions of the simplex technique are available, only the basic aspects of this procedure are reviewed.[33]

The sales and financing activities, $P_1 \cdots P_{20}$, and the restrictions, $R_{21} \cdots R_{39}$, may be presented in summary form as in Tables 45 and 46. The inclusion of the disposal activities, $P_{21} \cdots P_{39}$, would complete the matrix for Plan 1, i.e., the initial plan with zero income. In the starting merchandising matrix the c_j row specifies the unit values for each activity, including the disposal activities with zero unit values. The amount of the available requirement, R_i, is specified in the P_o column. Finally, the unit requirement for each activity, a_{ij}, is shown in the matrix proper.

The $z_j - c_j$ row in the starting matrix has both negative and positive numbers. Hence, there are two sets of possibilities: (1) to increase operating proceeds, and (2) to increase financing costs. The negative numbers for the sales activities indicate the operating proceeds lost by not including the specified sales activities in the program. The positive numbers for the financing activities indicate the financing costs avoided by not including the specified financing activities in the program. Inclusion of any sales activity in the program, however, incurs certain financing costs, i.e., expansion in a sales activity is accompanied by expansion in a financing activity. Requirements R_{26} and R_{39} provide for a level of financing in the transitional period and post-transitional period, respectively, to cover total financing requirements. It is possible to determine by inspection, therefore the stage that specifies an

---

[33]Charles E. French. Activity analysis: an agricultural marketing tool. Journal of Farm Economics. 37: 1236-1248. 1955.

Table 45. A starting merchandising matrix in a linear programming solution using the simplex method for nineteen situations and nineteen limitational factors, financing situation Aa

c_j Requirement	Vector	P_o	.0280 P_1	.1434 P_2	1.0000 P_3	.1334 P_4	.0119 P_5	.0512 P_6	.3514 P_7	.0412 P_8
April labor	P_{21}	17600	.0177	.0526	.6486	.0177	0	0	0	0
October labor	P_{22}	17600	.0104	.1005	.6486	.1005	0	0	0	0
Grain assets	P_{23}	10000	.0375	0	0	.1423	0	0	0	0
Sideline assets	P_{24}	13900	0	.1423	0	0	0	0	0	0
Other assets	P_{25}	14900	0	0	1.9864	0	0	0	0	0
Financing (I)	P_{26}	88900	0	0	0	0	0	0	0	0
Grain sales	P_{27}	53200	0	0	0	0	1	0	0	0
Sideline sales	P_{28}	61600	0	0	0	0	0	1	0	0
Other sales	P_{29}	4300	0	0	0	0	0	0	1	0
Non-member sales	P_{30}	15400	0	0	0	0	0	0	0	1
Loans	P_{31}	2500	0	0	0	0	0	0	0	0
Preferred stock	P_{32}	3600	0	0	0	0	0	0	0	0
Deferred refunds	P_{33}	53900	0	0	0	0	0	0	0	0
Surplus	P_{34}	23200	-.0060	-.0256	-.1757	-.0256	0	0	-.9839	-.1434
Equity ratio	P_{35}	16600	-.0753	-.3998	-.9864	-.3998	-.0753	-.3998	-1.9864	-.3988
Surplus ratio	P_{36}	0	.0753	.3998	.9864	.3998	.0753	.3998	1.9864	.3988
Productivity	P_{37}	0	-.0119	-.0512	0	.0512	-.0119	-.0512	0	0
Investment, members	P_{38}	13400	0	0	0	0	0	0	0	0
Financing (II)	P_{39}	0	0	0	0	0	.0743	.3917	1.9166	.3917
z_j			-.0280	-.1434	-1.0000	-.1334	- .0119	-.0512	-.3514	-.0412
$z_j - c_j$										

Table 46. A starting financing matrix in a linear programming solution using the simplex method for nineteen situations and nineteen limitational factors, financing situation Aa

z_j Vector	P_o	-.0550 P_9	-.0500 P_{10}	-.0710 P_{12}	-.1450 P_{13}	0 P_{14}	-.0550 P_{15}	-.0500 P_{16}	-.0450 P_{17}	-.0710 P_{18}	-.1450 P_{19}	0 P_{20}
P_{21}	17600	0	0	0	0	0	0	0	0	0	0	0
P_{22}	17600	0	0	0	0	0	0	0	0	0	0	0
P_{23}	10000	0	0	0	0	0	0	0	0	0	0	0
P_{24}	13900	0	0	0	0	0	0	0	0	0	0	0
P_{25}	14900	0	0	0	0	0	0	0	0	0	0	0
P_{26}	88900	1	1	1	1	1	0	0	0	0	0	0
P_{27}	53200	0	0	0	0	0	0	0	0	0	0	0
P_{28}	61600	0	0	0	0	0	0	0	0	0	0	0
P_{29}	4300	0	0	0	0	0	0	0	0	0	0	0
P_{30}	15400	0	0	0	0	0	0	0	0	0	0	0
P_{31}	2500	0	1	0	0	0	0	0	0	0	0	0
P_{32}	3600	0	0	1	0	0	0	0	0	0	0	0
P_{33}	53900	0	0	0	1	0	0	0	0	0	0	0
P_{34}	23200	0	0	0	0	1	0	0	0	0	0	0
P_{35}	16600	2.5	2.5	0	0	0	0	2.5	2.5	2.5	0	0
P_{36}	0	0	0	0	0	-4.0	0	0	0	0	0	-4.0
P_{37}	0	0	0	0	.1450	0	0	0	0	0	.1450	0
P_{38}	13400	0	0	0	0	0	0	0	1	1	0	0
P_{39}	0	0	0	0	0	0	-1	-1	-1	-1	-1	-1
z_j												
$z_j - c_j$		.0550	.0500	.0710	1450	0	.0550	.0500	.0450	.0710	1450	0

adequate financing plan for the sales possibilities available to the cooperative.

The transitional merchandising and financing problem may be stated as follows: Given the present assets, including personnel, and the present financial structure, what level of specified merchandising and financing activities would maximize the operating proceeds of the cooperative? The crucial limitations are provided by the assets structure, but some choice remains within these limitations as to the methods of financing to be employed. The first step, therefore, is to bring into the program the most profitable merchandising activity. The most profitable activity is P_3, or other income, with a unit value of 1.0000 dollars per dollar of sales.

The assets limitation on the other income activity, P_3, provides for a maximum sales level of 7,500 dollars, which is indicated by the minimum ratio, R_i/a_{ik}, where R_i is the total supply of the limitational requirement and a_{ik} is the unit requirement for the k^{th} activity.* The maximum permissible level of the chosen k^{th} activity, i.e., P_3, is entered in the r^{th} requirement row, i.e., R_{24}. A set of coefficients, a_{ij}, is computed for the r^{th} row, using the formula, $a'_{kj} = a_{rj}/a_{rk}$. The remaining coefficients are obtained by means of the formula, $a'_{ij} = a_{ij} - (a_{rj}/a_{rk})a_{ik}$.

The financing activities are entered into the program, as in the case of the merchandising activities, starting with the column having the lowest positive unit coefficient, c_j, i.e., P_{14}. In this case, surplus funds provide a costless form of financing, but they are limited by the available non-member business, as specified in the initial set of conditions

---

*Only non-negative ratios are considered. Selection of the smallest of these ratios ensures fulfillment of the non-negativity requirements.

for each financing situation. The most costly method of financing denoted by column, P_{13}, replaces the total financing requirement, R_{26}. Hence, the financing requirements of the transitional period are satisfied. Finally, the $z_j - c_j$ value for the total financing slack vector, P_{26}, shows a marginal financing expenditure of 0.1450 dollars per dollar of financing.

Completion of the financial program for the transitional period is followed by the programming operations that result in higher levels of the merchandising and financing activities, within the specified limitations. It is necessary, first, to introduce some capital funds to finance expansion in the most profitable merchandising activity. Members may be solicited for additional investment capital which would be obtained most economically in the form of five year, 4½ percent building notes, denoted by financing activity, P_{17}. The P_{17} column is entered in the appropriate row and thus enough capital funds are made available to include the other income activity, P_7, in the terminal program. Additional merchandising and financing activities are introduced into the program as long as any of the $z_j - c_j$ values for these activities remain negative. In the final program it is not possible to change any activity without a decrease in the total net savings.

Optimum financial plan.

The final plan specifies the levels of merchandising and financing activities for an optimum solution of the programming problem. Also specified are (1) the excess supply of requirements and (2) the marginal value products and marginal expenditures of the limitational requirements.

Optimum financial planning provides for the highest possible total net savings to the association, given the limitations that are in effect. It is possible to reach another optimum with the same set of coefficients, provided one or more of the limitations are relaxed, or the maximized function is changed. It is possible, moreover, to consider several intermediate phases of the over-all planning period, or changes in the values of the coefficients within each of the several phases. Hence, the assumptions upon which the linear programming technique is based may be satisfied despite (1) changes in the level of merchandising and financing activities and (2) changes in the agricultural economy.[34]

---

[34]The underlying assumptions of linearity, additivity, divisibility and homogeneity are discussed in Dorfman, Applications of linear programming to the theory of the firm, op. cit., and in Charnes, Cooper and Henderson, op. cit.

FINANCIAL ORGANIZATION IN SELECTED FINANCING SITUATIONS

The four financing situations may be described in terms of an optimum financial plan for a transitional period and a terminal period in each situation. Inasmuch as the applications of linear programming in this study are illustrative of the possibilities of this analytical approach to financing problems of cooperatives, the results are limited to (1) the transitional period for each of the four financing situations and (2) the terminal period for two of the four financing situations, i.e., financing situations Aa and Ba. The transitional period may be associated with the problems of financial management, or the minimization of financing costs consistent with the liquidity standards and conservation values of the association. The terminal period may be associated with problems of financial planning, or the development of a financial structure that provides for the long-run maximization of the net benefits of patronage and membership. Hence, the results are illustrative of the practical applications of the analytical techniques specified in the preceding chapter to problems of financial management and planning in specific elevator associations. The use of aggregative or inter-firm data, moreover, may provide a basis for the derivation of financial and operational standards to assist managers and directors of elevator associations in the performance of their duties.

Financial Management in the Transitional Period

The linear programming results in the transitional period may be

summarized in the following rule: Use the form of financing that minimizes financing costs within the postulated operating limitations. Two additional classifications may be specified: (1) elevator associations with full utilization of fixed facilities and personnel, and (2) elevator associations with excess capacity in each input category. It is assumed that in the first category the critical limitation is in the total assets of the association and that sales and financing limitations are not critical during this period. Each asset item would be used in the merchandising activity that results in the maximum operating proceeds to the elevator association with a specified membership. Hence, asset items that are substitutable among several merchandising activities would be used in the activity that resulted in the largest net increase in total operating proceeds with each additional dollar of assets transferred to that activity. Specialized assets would be fully utilized in a specified merchandising activity. Under-utilization of assets would occur when the value of the sales failed to cover the variable costs, i.e., cost of goods.

Elevator associations with full utilization of fixed facilities and personnel

Three merchandising activities are involved in the short-run situation with full utilization of resources. The non-member merchandising activity would not be competitive with the established sideline activity inasmuch as both activities have the same requirements, but non-member sales may incur an additional merchandising expense. Labor requirements per dollar of grain sales would increase during the low volume month of April to 128 percent of the average monthly rate, but during the month of

peak sales, i.e., October, unit labor requirements would decrease to 75 percent of the average monthly rate. On the same basis sideline sales would require 57 percent of the average monthly rate for the peak sales month of April and 109 percent for the slack sales month of October. It is assumed that a fixed labor supply would be available during the transitional period. Hence, variations in labor requirements per unit of sales depend upon variations in monthly sales (Tables 25 and 26). Labor requirements per dollar of storage and other services are assured at a constant level during the marketing year. Finally, it is postulated that on the basis of the total assets, the assets designed for use in storage and other services, i.e., the other income category, are only 10 percent as efficient in grain or sideline merchandising, and vice versa. However, assets designed for use in grain merchandising are 50 percent as efficient when used in sideline merchandising, while assets designed for use in sideline merchandising are 50 percent as efficient when used in grain merchandising.

These estimates are illustrative. Elevator managers, however, may have experience in substitution among different kinds of assets and hence they may have available the relevant estimates of varying degrees of subjectivity.

The linear programming procedure in this stage of the analysis involves a modification of the matrix used in the preceding chapter. The terminal merchandising and financing activities are omitted and, in addition, six transfer activities, $P_{1.2} \cdots P_{3.2}$, are employed to shift substitutable assets from one activity to another. The matrix for financing situation Aa, summarized in Table 47, shows the activities and requirements involved

Table 47. A starting merchandising matrix in a linear programming solution using the simplex method for nine activities and five limitational factors in the transitional period, financing situation Aa.

cj Requirement	P_o	.0280 P_1	.1434 P_2	1.0000 P_3	0 $P_{1.2}$	0 $P_{1.3}$	0 $P_{2.1}$	0 $P_{2.3}$	0 $P_{3.1}$	0 $P_{3.2}$
Labor, April	17600	.0177	.0526	.6486	0	0	0	0	0	0
Labor, October	17600	.0104	.1005	.6486	0	0	0	0	0	0
Assets, grain	10000	.0375	0	0	1	1	-.5000	0	-.1000	0
Assets, sidelines	13900	0	.1423	0	-.5000	0	1	1	0	-.1000
Assets, other	14900	0	0	1.9864	0	-.1000	0	-.1000	1	1
z_j										
$z_j - c_j$		-.0280	-.1434	-1.0000	0	0	0	0	0	0

(with the exception of the slack vectors, or disposal activities). The matrix for each of the other financing situations and the simplex operations are similar in each situation.

The linear programming results indicate the possible changes in day-to-day operations of specified elevator associations. The available flexibility in operations is essentially a matter of substitutability among different types of assets. Greater than the postulated degree of substitutability would provide for larger transfers of assets among the several activities and larger additional operating proceeds obtained from these transfers. In financing situation Aa it is not economic to shift assets among the three activities, but in each of the remaining three situations the gross operating proceeds are increased from 100 to 600 dollars by shifts in use of assets from grain merchandising to sideline merchandising (Table 48).

Table 48. Optimum merchandising program including optimum level of sales and gross operating proceeds, by specified financing situations

Item	Financing situation			
	Aa	Ab	Ba	Bb
	(thousand dollars)			
Grain sales	266.7	305.0	404.2	573.4
Sideline sales	97.7	171.0	295.1	370.4
Other income	7.5	12.2	14.7	26.0
Gross operating proceeds	29.0	40.7	68.1	102.2
Added proceeds	0	0.1	0.4	0.6
Assets transferred	0	1.0	3.1	0.3

Full utilization of the available labor supply may be obtained by an increase in the level of sideline merchandising. In the short run, asset limitations, however, obstruct the readjustments in the combination of merchandising activities that would provide for full resource utilization.

An optimum financial plan for the transitional period must be defined in terms of the initial financial structure of the cooperative. Short-term financing, i.e., notes payable, to meet varying seasonal requirements generally provides the most economical form of financing during this period. The availability of short-term financing is affected by the financial condition of the cooperative as well as other local considerations. Full utilization of the fixed facilities, however, limits the level of the merchandising activities and hence the immediate need for additional financing.

Elevator associations with under-utilization of fixed facilities and personnel

Short-run opportunities for reorganization of the financial structure in elevator associations that are faced with under-utilization of both fixed facilities and personnel are limited to the current liability accounts. Fixed assets would be utilized in their specialized functions. The critical limitations, however, appear in merchandising, i.e., under-utilization of of available facilities, rather than in financing. Financial reorganization involves, therefore, long-run rather than short-run considerations in financial planning.

Financial Planning in the Terminal Period

Most financial problems in elevator associations involve long-run

changes in their merchandising activities and in their assets. Hence, the most significant contributions of financial planning are made over a period of time and in relation to a long-run view of the economic needs and possibilities of the cooperative. The linear programming procedure presented in the preceding chapter is adapted to the two-fold approach to financial planning and management: it denotes the immediately feasible combination of merchandising and financing activities, but it provides, also, for the optimum long-range merchandising and financing program. Two financing situations are presented, including their initial merchandising and financing activities and the optimum long-range program. In each case, it is assumed that maximization of the net savings of each member, in this instance, the net savings of the association, is the relevant choice criterion. Opportunity costs of the financing resources of members employed in the cooperative are included among the variable operating expenses. The two financing situations involve two different sets of financing preferences and opportunity costs for member capital. They involve, also, two different potential levels of merchandising activities. The interdependence between the two kinds of restrictions, i.e., financing and merchandising, are indicated in the linear programming solutions.

Elevator associations with low sales and high marginal productivity of member capital

Long-range financial planning in the cooperative association involves (1) estimates of the sales potential by specified merchandising activities, (2) estimates of capital productivity on member farms, (3) estimates of

available capital funds among members for investment in the cooperative under specified terms, and (4) estimates of the member preferences in financing, including investment preferences of farmers with surplus funds to invest for income. Data presented in preceding chapters provide the bases for the estimates in the linear programming solutions. The initial financial structures differ from the data specified in Table 41, but these adjustments are minor and do not affect the illustrative value of the following presentation.

Potential and optimal levels of merchandising activities in financing situation Aa are summarized in Table 49. The potential levels of sales are realized in all merchandising activities. Expansion of non-member sales, in this case, is profitable to the membership as an economical source of financing, particularly in view of the high opportunity cost for member capital retained in the cooperative. However, the cooperative thus may lose its cooperative character. In this situation it would be advisable to increase the membership to obtain a larger sales volume and hence the income and collateral bases for expansion of available financial resources.

Table 49. Optimum merchandising program, including sales and total financing requirements, financing situation Aa.

Item	Grain	Sidelines	Other income	Non-member	Total
			(thousand dollars)		
Sales	319.9	158.7	11.8	15.4	505.8
Total financing[a]	24.5	64.7	24.1	6.3	136.1

[a]Including financing of jointly utilized assets.

The optimum financial plan in financing situation Aa illustrates the nature of the financing difficulties encountered in an elevator association with low sales potential (Table 50). The available financing is adequate during the transitional period inasmuch as all expenses are assumed as fixed, with the exception of financing costs, and hence the total gross operating proceeds may be used to cover the financing costs. Future expansion, however, involves a cost structure comprised entirely of variable costs, which must be deducted from the gross operating proceeds to obtain the relevant income component. Future plans, therefore, require consideration of alternative uses for the available financing, including the alternative uses for these funds in the participating farm enterprises.

Table 50. Optimum financial plan, including initial financial structure, new financing and terminal financing structure, financing situation Aa.

Item	Initial structure	New financing	Terminal structure
		(thousand dollars)	
Accounts payable	3.6	0.9	4.5
Notes payable	3.3	15.2	18.5
Mortgage loans	2.5	32.6	35.1
Building notes	0	0	0
Total	9.4	47.8	56.0
Memberships	2.4	0	2.4
Preferred stock	3.6	9.8	13.4
Deferred refunds	53.9	-24.7	29.2
Surplus	23.2	11.7	35.1
Total	83.1	- 3.0	80.1

The optimum organization of the merchandising and financing activities in financing situation Aa results in gross operating proceeds of 23,776 dollars during the transitional period, and additional net operating proceeds of 1,736 dollars per year during the terminal period. The utilization of the available resources and requirements are indicated in Table 51. The limiting factors effective only during the transitional period, P_{21} ... P_{26}, have a relatively large marginal value per dollar of the factor because all outlays were predetermined for this period. In comparison, the marginal value of the limiting factors in the terminal period are relatively small. The additional other income activity, however, has a marginal value of 30 cents per dollar of other income. Non-member sales also provide an additional source of financing, but the asset requirements per dollar of net operating proceeds are larger than for the other income category. It may be noted, finally, that the total financing requirement may be represented as a marginal cost per unit of additional financing required.

Analysis of the optimum financial plan illustrates further the importance of (1) member preferences, (2) collateral requirements of lending institutions, and (3) marginal productivity of capital on participating farms. It is assumed that member preferences in financing coincide with the collateral requirements of lending institutions in terms of the objective criteria for each, i.e., the equity ratio. A sixty percent equity ratio is preferred by members and required by lending institutions. A higher equity ratio in either case would impose further restrictions on available financing and hence on the expansion of merchandising facilities.

Table 51. Optimum resource use, including available quantity, unused quantity and marginal value, financing situation Aa

Requirement	Vector	Available quantity	Unused quantity	Marginal value
		(thousand dollars)		(cents per dollar)
April labor	P_{21}	17.6	2.9	0
October labor	P_{22}	17.6	0.2	0
Grain assets	P_{23}	10.0	0	84.22
Sideline assets	P_{24}	13.9	0	113.50
Other assets	P_{25}	14.9	0	55.22
Financing (I)	P_{26}	88.9	0	-14.50
Grain sales	P_{27}	53.2	0	.42
Sideline sales	P_{28}	61.6	0	1.08
Other sales	P_{29}	4.3	0	29.73
Non-member sales	P_{30}	15.4	0	2.15
Loans	P_{31}	2.5	0	0.50
Preferred stock	P_{32}	3.6	0	0.50
Deferred refunds	P_{33}	69.0	39.8	0
Surplus	P_{34}	35.1	0	14.50
Equity ratio	P_{35}	134.0	0	3.60
Surplus ratio	P_{36}	163.1	22.8	0
Productivity	P_{37}	12.0	7.7	0
Investment, member	P_{38}	13.4	0	6.90
Financing (II)	P_{39}	14.3	0	14.00

High productivity of capital resources on participating member farms restricts the financial structure and the merchandising program of the cooperative. Limited sales potentials for merchandising activities with high net operating proceeds per unit of financing requirement, further confines business operations. Non-member business provides a much needed source of financing, but it, too, is limited by the market area.

Hence, market limitations, which are affected by the quality of management, rather than financing limitations, are the critical limitations in the so-called financing problems of farmer cooperatives.

Elevator associations with high sales and low marginal productivity of member capital

Financing situation Ba includes elevator associations with relatively high volume of sales but with relatively low change in total assets over the four year period, 1950-1953. The members and the directors of elevator associations in this group may be characterized by a preference for conservative forms of financing that involve low rates of indebtedness. The equity ratio may exceed 0.9 for the average cooperative in this group and hence the financing structure would comprise largely, deferred refunds and surplus. However, a substantially lower equity ratio is postulated in the linear programming example.

Market (or management) limitations define the optimum merchandising program in financing situation Ba. The terminal program shows the following:

Financing expense	$ 8,400
Other operating expense	50,200
Net operating proceeds	28,000
Gross operating proceeds	$86,600

Financing expense includes the opportunity cost of patronage refunds retained in the cooperative. Total financing requirements are 273.1 thousand dollars in the terminal program.

The financial structure in financing situation Ba is burdened ex-

cessively with current liabilities, which is not typical of elevator cooperatives in this situation (Table 52). The terminal financial structure illustrates, however, the importance of available financing at relatively low interest rates. In this financing situation it is also profitable to retire preferred stock.

Table 52. Optimum financial plan, including initial financial structure, new financing and terminal financial structure, financing situation Ba

Item	Initial structure	New financing	Terminal structure
		(thousand dollars)	
Accounts payable	8.6	3.4	12.0
Notes payable	7.9	113.5	121.4
Mortgage loans	1.6	0	1.6
Building notes	0	29.7	29.7
Total	18.1	146.6	164.7
Memberships	15.6	0	15.6
Preferred stock	34.9	-34.9	0
Deferred refunds	82.2	-76.8	5.4
Surplus	63.1	24.3	87.4
Total	195.8	-87.4	108.4

An equity ratio that approaches 100 percent would provide adequate capital only for merchandising activities that yield relatively high net operating proceeds per dollar of assets utilized, i.e., in excess of the effective interest rate per dollar of financing requirement. Historically, the cooperative associations that have expanded most rapidly utilized a relatively large amount of bank notes and other forms of indebtedness (Appendix). Cooperatives in a favorable competitive situation with

relatively large margins and a large volume of sales may expand with very little external financing. The net benefits of membership may exceed the subjective discounted opportunity costs of member capital and hence the membership may willingly support the merchandising activities and financing practices of their cooperative.

EVALUATION OF RESULTS

The approach to financial planning in a cooperative association developed in this study is faced with at least two serious difficulties: (1) paucity of required data, and (2) prodigious computational procedures. These difficulties, however, fail to invalidate the analytical approach. Inherent in this approach is the facility to deal with a multitude of factors that impinge upon the decision-making process and the economic environment in a cooperative association.

It is a purpose of this study to evaluate the available data required in a linear programming application and to indicate the shortcomings in these data. A subsequent stage may involve a specific cooperative association, or a small group of cooperative associations, where the technician deals with individual commodity groups, monthly time intervals and many different and unique institutional and membership considerations. The present stage, however, cannot be discarded entirely in favor of more specific applications. The development of standard costs as guides to management as well as data for more general research applications of the mathematical programming technique depend upon information from selected samples of cooperative associations over considerable periods of time.

The evaluation of results will follow the outline of the study and include (1) the basic data, (2) the analytical model, and (3) the application of the model in dealing with financing problems of cooperative associations. Extension of findings to so-called practical financing problems will be included in the discussion of the linear programming

application.

Basic Data

Statistical procedures for collection and processing data to meet research needs may be improved by re-definition of the relevant population to include a more restricted group of elevators. In addition, the stratification of the population may be obtained solely on the basis of a single criterion, e.g., type of farming area, for each type of elevator association. An enumeration of the data requirements of a linear programming application may suggest additional statistical considerations in the design and completion of an adequate survey to obtain the basic data.

Merchandising requirements and potentials.

A linear programming application involves collection of a vast amount of input-output data and estimates of available resource requirements. In this application operating statements for 86 elevator associations and field surveys of the membership of eight of the 86 associations provide most of the data requirements. Multiple regression equations were used in the construction of the input-output coefficients. The non-homogenous cost and resource functions involved a fixed component, which entered into the total financing requirements, and a variable component. Further research is needed to ascertain the structure of costs and resource utilization in elevator associations and the nature of the relevant input-output functions.

The critical importance of the market area in defining the merchan-

dising possibilities available to a cooperative may be determined by a thorough examination of the location, or market, factors affecting the business success of a cooperative elevator association. Again, further research is needed to develop practical methods of estimating the market factors, and hence the sales possibilities, for particular elevator associations.

Additional refinement of data may be obtained from monthly operating statements and the accounts of day-to-day transactions. Resource limitations are in effect over a several week period rather than over the entire marketing season. It is important, therefore, to obtain a monthly distribution of labor and other resource requirements of each merchandising activity.

Operating proceeds.

Estimates of specified operating proceeds by months and by years are needed to evaluate the merchandising possibilities. It is necessary to obtain month-by-month estimates of gross operating proceeds and operating expenses to determine the financing requirements for the fiscal year. Variations in physical quantity of sales, prices and margins affect the level of operating proceeds for a single month. Estimates of average monthly operating proceeds, therefore, may be derived from estimates of its several components. Postulated changes in physical quantity of sales, prices and margins would result in different value coefficients in the linear programming problem and hence in different optimum merchandising and financing plans.

Complementary relationships among different merchandising activities

may yield optimum plans that differ from the optimum plans under the assumptions in this study. It is apparent that sideline sales and grain sales are complementary, i.e., an increase in grain sales generally is associated with an increase in the trade area and hence in the volume of all sales. The margin per bushel of grain, however, may show an inverse relationship with the volume of grain purchases or sideline sales. Complementary relationships in sales may be handled through the use of additional merchandising activities that provide for a sideline sales potential dependent upon the volume of grain merchandising. Further investigations are needed to establish the degree of such complementary relationships in merchandising.

Financing costs.

Most of the financing costs, with the exception of the interest changes and opportunity costs of deferred refunds and surplus, may be absorbed in the normal operating expenses of the cooperative associations. The long-run estimates of financing should include the additional cost of obtaining and utilizing the funds. Further investigations are necessary to ascertain the nature of these costs over varying time intervals and the way in which the costs enter in financing decisions in cooperative associations.

Financing costs are only one set of factors influencing financing decisions. The manager of a cooperative may prefer a higher cost of financing to limitations in his freedom of action. In either case, the management's evaluation of alternative financing sources affects the ultimate costs of financing which must be covered by the operating proceeds of the

business or by the net benefits of patronage and membership. Lack of available data on the total structure of financing costs limits the usefulness of the present study.

Resource productivity.

Estimates of resource productivity among members of specific cooperative associations may be obtained by comparison with other areas for which values have been ascertained. The relative marginal productivity values may provide, therefore, criteria for efficient resource utilization among farm and non-farm activities. Research results, however, suggest that the process of discounting resource returns in different types of production activities may result in a different pattern of resource use than indicated by the static analysis. Hence, it is important to examine further the discounting phenomena as it affects investment choices among alternative opportunities.

Member preferences.

Quantitative measures of member preferences may have an ambiguous interpretation. Such preferences, however, are among the most critical factors affecting the economic possibilities of the cooperative association. Member preferences in financing the cooperative, as well as in choosing among alternative investment opportunities, define generally the financial structure of the cooperative and hence the possibilities for expansion and realization of the sales potentials in the market area. Estimates are needed, therefore, of member preferences in financing in each local elevator association and, where generalization is useful, in

each financing situation.

Institutional restrictions.

Banks and the legal requirements of the State that pertain to cooperative businesses impose restrictions on the merchandising and financing possibilities of cooperative associations. Hence, collateral requirements of banks must be ascertained, as well as the legal requirements of the State, as they apply to each cooperative association, or a technical programming situation.

Analytical Model

The validity of the analytical model may be questioned on several issues, including the economy of application. An adequate model would require the use of high-speed electronic computors, but an incomplete model may provide some useful information with a minimum of computational difficulties. Specific evaluations may include (1) the underlying assumptions, (2) the choice criterion, (3) the decision-making framework, and (4) the planning interval.

Assumptions.

Economies and diseconomies of scale occur frequently in agricultural marketing. Complementarity in demand for the output of the marketing establishment is another important consideration. A solution to each of these difficulties is the inclusion of additional merchandising activities until the actual conditions are adequately approximated under the assumptions of linearity and additivity. Moreover, restrictions may be imposed

in the definition of feasible solutions, thus to meet partly the difficulty of dealing with large fixed inputs, e.g., elevator head and bins, under the assumption of resource divisibility. Finally, the optimum organization of activities is limited to the total number of activities included in the initial plan, which may comprise the most serious weakness in the underlying assumptions.

Choice criterion.

Members of cooperatives may maximize a complex of values, if they were to choose rationally among alternative opportunities and obligations. Hence, the assumption of rationality is prior to the assumption of a maximizing criterion. But if members of a cooperative, through their elected board of directors attempt to improve their economic position by a rational process of decision-making, they may discover alternative values to maximize and, hence, the need to choose among these values. An index criterion may be devised, or a simple criterion may be selected, subject to certain restrictions, that satisfies the membership. A recent Iowa study indicates net savings as a primary inducement to membership in a cooperative.[1] Selection of an appropriate choice criterion may involve further investigation of the particular programming situation.

Decision-making framework.

Members and directors of cooperatives may make a different set of

---

[1]George M. Beal, Donald R. Fessler and Ray E. Wakeley. Agricultural cooperatives in Iowa: farmers' opinions and community relations. Ames, Iowa Agr. Exp. Sta. Res. Bul. 379. 1951.

financing decisions, both in sequence and in content, than those indicated by the linear programming solutions. The discrepancy between the two solutions may stem from differences in (1) available information and (2) preference structures. The decision-making process employed by members and directors may include additional qualitative considerations. The linear programming solution, therefore, may provide only partial information to the members and directors in their final decision-making.

The adaptation of the theoretical model to problems in financing involves the related problems of capital budgeting and capital expenditures. Inasmuch as capital expenditures decisions relate to the long-run problems of expansion and growth in cooperative facilities, a survey of capital requirements in the cooperative would be based on the discovery and creation of opportunities for capital expenditures in new services or improvements of old services.[2] A survey to determine what investments are needed to provide necessary services would be the first step in estimating its capital requirements. Moreover, the contribution of each investment to the net savings of the cooperative must be estimated. Thus, it would be possible to construct a demand schedule showing the increment in net saving associated with each additional investment dollar.

Investment expenditures are of many different forms. They cannot be classified under a general category, e.g., fixed assets. A useful classification would include the following categories of investments: (1) re-

---

[2]Cooperative literature stresses the competitive yardstick role as a justification for cooperatives. H. E. Erdman: Possibilities and limitations of cooperative marketing. Berkeley, California Agr. Exp. Sta. Circular 298. 1942.

placement investments, where the source of additional net savings is in cost savings; (2) expansion investments, where the additional revenue accrues from an increased volume of business; (3) product investments, where the additional net savings are a result of both replacement and expansion investments, and (4) strategic investments, where long-run investments result through risk reduction or personnel improvement.[3]

Investment in fixed assets involve each of the categories of capital expenditures. Investment in regionals may be classified as strategic investments while investments in current assets complement the investment in fixed assets, largely in the form of expansion investments and product investments. The contribution of net savings of each proposed investment must be estimated and compared with the least-cost method of providing the service without the new investment. The mathematical programming technique may be applied directly to these problems of capital expenditure and capital budgeting. The selection of an optimum combination of merchandising activities determines the optimum capital expenditures program for the cooperative.

Management and planning interval.

The use of several time periods in the linear programming model makes possible a differentiation on the basis of (1) accuracy of data, (2) changes in technology and anticipated prices, and (3) nature of the decision-making process. A transitional period and a terminal period provide at least for a distinction between information required in day-to-day

---

[3]Joel Dean. Capital budgeting. New York, Columbia University Press. 1951.

management decisions and information required in planning a capital expenditures program and a financing plan that is adequate for the proposed expansion program. In the first case, the merchandising, i.e., input-output, coefficients may be estimated with considerable accuracy and anticipated prices may be estimated with a high probability of expectations. In addition, a forecast is available, using the best available data, of required changes in merchandising and financing activities to attain an optimum program at a future date. Hence, management decisions may be made in terms of long-run frame of reference.

Intermediate periods within the over-all planning period allow for changes in prices, coefficients, and expectations. Hence, an optimum program may be derived for the first year and each succeeding year. Acquisition of high-speed computors will make this application feasible but presently the computational costs would be excessive.

Application

The criteria used in the definition of a financing situation, i.e., (1) average annual net operating proceeds and (2) change in total assets, each over a four year period, stem from an initial hypothesis that financing conditions in cooperative elevator associations are significantly different when the elevators are grouped according to these criteria. Elevators with relatively large net operating proceeds are in a more favorable position to expand and to finance this expansion. But the opportunity costs of member capital, in the form of their allocated share of the net operating proceeds, may indicate a more profitable use for this capital on the member farms. Furthermore, a large membership will have

a relatively large total net operating proceeds. Additional criteria are required, therefore, to establish the economic availability of internal sources of financing.

Elevators with a recent history of relatively large growth in total assets have access to external sources of financing, as indicated by their financial statements. The criterion of change in total assets identifies in an ex post sense elevators that have a financial structure characterized by a relatively large indebtedness.

Aggregation of data.

The composite nature of the merchandising activities in the study make the present approach largely of illustrative value. It will be necessary in future studies to deal with specific merchandising activities, e.g., petroleum, lumber, feed, miscellaneous supplies and grains, and with physical quantities or indexes of physical quantities. The descriptive material included on mark-up practices and on the combinations of merchandise handled shows wide differences among elevators, which may be related to the profitability of business operations and other factors affecting financing decisions. Moreover, these activities have varying resource requirements and varying degrees of substitutability among resource requirements over the marketing year. The disaggregation of data require at least seven merchandising activities, i.e., the five specified above plus (1) storage and handling of government grain and (2) custom grinding, drying and other services. Several non-member activities may be devised as well as two or more activities for business handled through the regional associations. A similar set of activities would be involved for each planning or manage-

ment period.

Physical plant requirements.

New investment in the physical plant of the association may involve the deliberation of the membership and directors as well as the manager. The information needed in the management and policy deliberations depends on the nature of the investment. Replacement investment decisions involve only cost data; the problem is simply finding the least-cost way of doing a specific task. Expansion and product investments require productivity data and involve the decision of whether or not to perform the service. Strategic investments, finally, are based much more on judgment and long-run goals of the association.

Replacement of buildings and equipment. Cost projections are the basis for either (1) replacement due to wear-and-tear, or (2) replacement due to obsolescence. Cost comparison may be made between an old and new asset, e.g., truck, based on the behavior of the components of total costs. Dean has classified the total cost components as (1) capital wastage cost, (2) operating cost, (3) maintenance cost, and (4) unreliability costs (e.g., breakdowns and idle time for repairs).[4] The cost comparisons are essentially the same for the two kinds of replacements, except that replacements due to obsolescence depend, also, on the standard of productivity for each asset item in each cooperative.

Comparisons of the future costs of two asset items, one old and one new, are beset with many difficulties. First, the estimate of the capital

---

[4] Ibid.

wastage cost, i.e., purchase price, less resale value, depends on an estimate of its probable economic life, which, in turn, involves an estimate of when it will become obsolete. Second, it is not enough that the new asset create a cost saving over the old, but that it create a cost saving at least equal to the current rate of net savings, i.e., per dollar of investment. Estimates of future net savings, as well as costs, are needed as a basis for the replacement decisions.

Expansion investments. Estimates of sales, gross margins and operating costs are required for expansion investments. Each of the factors are subject to wide margins of error. Sales and gross margins estimates, by commodity groups, are related to unpredictable factors as (1) number and percent of potential customers who would patronize the cooperative given certain inducements, (2) competition from other businesses, and (3) pricing policies.

Operating cost estimates involve economies of larger plants and decisions to build capacity in anticipation of expected future sales. The difficult question is to know how far in advance of sales to build. Operating costs vary, of course, with capacity of plant as well as its rate of utilization.

Additional net savings resulting from expansion investments represent the difference between additional gross margins and additional operating costs. Expansion investments, therefore, involve comparisons between the net savings of alternative ways of expanding sales without making the expansion investments and net savings with the expansion investments. The lack of adequate estimates for expansion investments may result in discounted net savings estimates that vary widely among directors and managers.

Product investments. The addition of new departments, or a new line of sideline or services, may result in better use of existing facilities. They may, in addition, increase the volume of existing sales or services. The total effects of product investments, however, would be difficult to estimate.

The return on product investments may be estimated from forecasts of sales, prices, and costs, including the costs of increasing patronage in the new product. Many of the estimates must be based merely on the belief that with the proper kind of management and economic conditions the cooperative will increase its patronage and its net savings to a point that will justify the capital expenditure.

Investment in regional cooperatives.

Regional cooperatives handle commodities for the member cooperatives on a competitive basis, i.e., regionals generally match independent wholesale businesses on prices. Patronage refunds earned by the local elevators in their regionals would be equivalent to the profits an independent business would make on the same patronage, provided sales, margins and costs were the same in the two kinds of businesses. The local elevators maintain an active interest in the patronage refunds retained by the regionals, however, because of the relationship between the two kinds of cooperatives. (1) Patronizing regionals, in the first place, is a demonstration of the local cooperative's willingness to take on the responsibilities of membership, e.g., control, uncertainty-bearing, financing. (2) Patronage refunds retained in the regional involve forms of investment expenditures listed above, e.g., expansion expenditures, product

expenditures, and strategic expenditures. The expenditures are predetermined, however, depending upon the amount of patronage and the established policy on retention of patronage refunds.

Current asset requirements.

The commodity sales and services of the cooperative require certain minimum amounts of inventory, accounts receivable and cash. Each commodity line requires a minimum inventory level depending upon daily sales, seasonal trends in sales, expected changes in demand and cost relations, uncertainty of future demand, and changes in re-order time.[5] An optimum inventory level involves the relation of inventory costs to the gains in sales associated with each additional unit of inventory. The accounts receivable requirements also vary among different commodities (as well as different associations). A strictly cash policy would be impractical for all commodity lines or for all cooperatives because of varying degrees of competition from similar businesses that do grant credit. Finally, the level of average cash balances differs among cooperatives, as a result of differences in commodities handled, new financing, net savings, capital expenditures and preferences of management.

Inventory. The environment of inventory decisions involves consideration of both economic and technological factors in grain and sideline merchandising. First, most commodities handled by a cooperative have a seasonal pattern of inventory accumulation, e.g., grain in November, lumber in March. It may be necessary to divide the marketing year into two parts

---

T. M. Whitin. The theory of inventory management. Princeton, N. J., Princeton University Press. 1953.

on the basis of inventory accumulation; the first part, when inventories accumulate, and the second part, when inventories are depleted.

An economic model of the decision process in inventory management involves the inventory relation in somewhat different form; the difference between inventory gains and inventory costs, per unit of sales, is maximized. The inventory costs are related to sales, but in addition, they are related to the rates of ordering, and other factors. Inventory costs include (1) storage costs, i.e., costs of fixed assets required to handle the total inventory, (2) interest cost on capital funds tied up in inventory, (3) insurance, (4) operating costs, e.g., re-order costs, and (5) losses, e.g., deterioration and price fluctuations. The inventory gains (losses) result from (1) expected change in price and (2) expected change in sales. Maximization of the difference between inventory gains and inventory costs, however, must be consistent with the maximization of average net savings for the cooperative.

In summary, ex ante estimates of inventory requirement in a cooperative involve (1) estimates of future sales of specified commodities, (2) estimates of future margins on each commodity line, (3) estimates of future costs of operation, and (4) estimates of changes in sales, margins and costs associated with unit change in inventory. Also needed are (1) the inventory costs associated with different inventory levels in each commodity line and (2) the gains in sales associated with an increase in inventory. Finally, the optimum inventory level must be consistent with the optimum level of fixed assets and the preference systems of members and management.

Accounts receivable. The amount of receivables carried on the books

of a cooperative is related to the products handled, general business trends, available financing, and capital position of members, as well as the credit policy of the cooperative. The monthly variations in the use of retail credit are related to the receipts of farm income, the commodites handled, and the competitive situation facing the cooperative. Credit sales, according to Knudtson and Koller,[6] vary more than total sales or accounts receivable. The three variables, however, tend to move together for each commodity. Peak credit sales of farm supplies occur in April and May while petroleum sales reach their peak one to two months later. The seasonal pattern of accounts receivable, therefore, will vary among elevators depending upon the percentage distribution of the commodities handled. Finally, the period over which the credit is granted, e.g., spring to fall credit, increases the chance for default on the account because of crop failure or unfavorable prices, and thus increases the amount of accounts receivable and bad debt loss for the year.

The economic objective in the management of accounts receivable credit is the same as in the management of any other assets, i.e., maximization of the over-all average net savings of the cooperative. Average net savings may be maximized by granting some accounts receivable credit when the competitive situation forces the cooperative to grant credit on terms similar to those of competitors. The gain in sales, however, must be related to the cost of the additional credit. These costs include (1) personnel expenses, (2) office supplies, (3) collection and legal expense,

---

[6] Arvid C. Knudtson and E. Fred Koller. Accounts receivable credit in Minnesota farm supply cooperatives. St. Paul, Minn. Agr. Exp. Sta. Bul. 430. 1955.

and (4) bad debt loss. In the Knudtson and Koller study these costs totaled 56.2 cents per 100 dollars of total credit sales for the sample of cooperatives and 39.9 pents per 100 dollars of total credit sales for the grain associations in the sample. The inclusion of interest at 4.5 percent on the average monthly receivables increased these costs to 95.2 cents and 74.4 cents, respectively, per 100 dollars of total credit sales. The management objective, therefore, is to maximize the difference between the gain in sales and the cost of credit in terms of the over-all maximization objective (subject to the relevant preference systems).

In summary, the decision process in the management of accounts receivable credit may be depicted in terms of an ex ante relation which requires the same set of estimates as in the inventory relation and the fixed asset relation. In addition, estimates are needed of (1) the quantity demanded of accounts receivable credit, and (2) the credit costs associated with each additional dollar of credit sales.

Cash balance. The cash balance account provides flexibility in the financial management. The available cash may be used to meet the periodic expenditures of the cooperative and, also, as a cushion for unpredicted demands for cash. Efficient management of the cash balance account requires careful planning on part of the manager and board of directors. Sources of seasonal financing must be tapped to complement the cash sales and payments on receivables in a way that minimizes the excess cash balance over the year. Managers and directors of cooperatives differ in ability and preference regarding the use of different sources of financing and the management of the asset accounts. Hence, the average monthly cash balance per dollar of specified sales is likely to differ

among cooperatives.

The decision process in cash management involves the maximization of the difference between the gains attributable to an adequate cash balance and the costs of maintaining that balance in terms of the over-all average net savings relation for the cooperative. The cash balance, relation, however, is subject to the liquidity preference of management (as well as other preferences enumerated above). The estimates involved in the prediction equation include the previously listed estimates of sales, margins and costs, plus (1) estimates of the gain in sales attributable to an adequate cash balance, and (2) estimates of the costs of cash management (exclusive of interest cost).

Effect of investment decisions on financial management.

The different kinds of assets, each with a unique set of prediction variables, impose different financing requirements. The availability of the particular kind of financing, in turn, affects the investment decision, or finally, the kind and amounts of capital expenditures. The interrelation between investment decisions and financial management involve (1) length of turnover of assets, (2) rate of return and net savings, (3) risk and uncertainty, (4) ownership and control, and (5) annual asset costs of different forms of assets.

Length of turnover of assets. Assets with rapid turnover, e.g., inventory, usually involve short-term financing while assets with slow turnover, e.g., buildings, are financed largely by surplus and other permanent capital. The elevator cooperatives, however, are characterized by a dependence on long-term member financing, although cooperatives

with recent expansion generally obtained bank loans to start the expansion program.

Local banks and the Omaha Bank for Cooperatives make short-term loans, secured and unsecured, of varying amounts and at an interest rate of 4.5 to 6 percent. The results of the finance survey of 103 farmers' elevators show a willingness of managers to pay approximately one-half percent more interest on inventory loans than loans on fixed assets (which may reflect the current structure of interest rates). Yet, nearly all of the needed expansion was in fixed assets rather than current assets. Presumably, short-term financing is more available than long-term financing. The presence of internal or external capital rationing in long-term financing may account for both the greater availability of short-term financing and the greater interest rate which managers are willing to pay on short-term loans.

Rate of return and net savings. The rate of return on proposed capital expenditures may be used as a choice criterion for alternative investment opportunities. The net return on the investment (exclusive of interest expense) provides the cash funds to pay for the annual cost of the capital funds. Finally, the cumulated depreciation charge covers the initial outlay cost.

The payment period, i.e., the time required to pay back the investment from gross earnings, is a commonly used criterion in capital budgeting. The payment period, however, fails to discriminate between two equal capital expenditures with the same gross earnings but which differ in their total useful life. Thus, the use of a short pay-out period may be inconsistent with the maximum rate of return criterion.

The rate of return criterion, i.e., the net savings, per dollar of investment, or the net savings criterion, i.e., net savings per dollar of sales, are related to the cost of capital funds. Capital expenditures are made only when the discounted net savings are at least as great as the total cost of the capital funds, including the opportunity costs of member capital. The net savings criterion specified in the analytical framework is subject, therefore, to the additional condition that the net rate of return exceed the cost of capital for any capital expenditure.

Risk and uncertainty. The elements of risk and uncertainty are involved in both investment decisions and financial management. Members and directors may prefer only limited expansion to the indebtedness involved in a more ambitious expansion program. Moreover, more risk investments may require equity financing entirely because of the preferences of members and directors, or because of external capital rationing.

Management, also, is concerned with the risks and uncertainties associated with different investments and different forms of financing. Managers may prefer expansion and the related increase in inducements, but they may prefer the expansion only if the loans initially used to finance the expansion program are replaced by interest-free member equities Managers may have an aversion to interest obligations, even to members. Management, therefore, may prefer to finance largely from surplus and the revolving fund.

Ownership and control. Members of elevator associations have a distinct preference for capital expenditures in production activities that they control directly. Productive investment opportunities in cooperative associations are thus often passed by for less productive capital

expenditures in the members' farms. Hence, the element of control in financial management has decisive influence on capital expenditures. Productive capital expenditures may be voted down in the cooperative as long as the members and directors feel that they have an inadequate "voice" in the investment decision process, or their individual interests are in conflict. Financial management, however, involves the management of the financial resources of the cooperative in a way that maximizes the long-run profits of the individual participating farms. Methods of financing are needed which are consistent with the economic interests of individual members as well as the heterogeneity of interests among members in a particular cooperative association.

Capital expenditures program.

The application of the linear programming technique to problems of financial planning in the financial organization of cooperative associations involves a unique set of activities, i.e., merchandising and financing. First, the interest of members and directors of cooperative associations is in the merchandising program, inasmuch as the cooperative was organized to provide a needed service at cost. Members are in a position to choose among alternative methods of merchandising their agricultural products. They may select an independent agricultural business to perform the needed marketing services, or they may have these services performed by their cooperative association. Hence, the primary decision regards the optimum organization of merchandising services.

The optimum organization of the financial structure is associated with the over-all problem of financial organization in the cooperative

association. The capital expenditures program is related to the organization of the merchandising activities and the financial structure. Hence, the optimum financial organization involves, (1) an optimum organization of merchandising activities, (2) an optimum capital expenditures program, and (3) an optimum organization of the financial structure.

The capital expenditures programming may be handled within the framework of this study. An additional requirement vector is needed for each component of the capital expenditures program, e.g., buildings, equipment, inventory, accounts receivable and cash. The total financing must cover these assets. Substitution between assets in the same activity may be accomplished through the use of capital expenditures activities with assigned unit costs.

Seasonal merchandising requirements.

Seasonal merchandising requirements, e.g., labor and short-term financing, may be incorporated into the programming problem. Limited computational facilities permitted the use of only one seasonal requirement, i.e., labor. The available monthly data on margins, physical volume of sales, and operating proceeds also may be utilized to obtain the input-output coefficients for the critical months.

The use of monthly data involves additional methodological and practical difficulties. The level of day-to-day financing requirements depends upon management practices with respect to inventory, accounts receivable, accounts payable and cash. The discussion of specific current asset requirements indicated the nature of the decision-making environment in each of these areas. Research in these management areas

may be devised that would show the factors involved and their quantitative relationships. These research results would make possible a more detailed application of the linear programming technique to problems of financial organization.

SUMMARY AND CONCLUSIONS

Financial organization in farmer cooperatives comprises the financial structure and the processes of management and planning. It was the purpose of this study, therefore, to analyze and to compare historical and optimum financial organizations in specified financing situations and to evaluate the application of an integrated approach, i.e., activity analysis or linear programming, to financial management and planning in farmer cooperatives.

It was postulated in the study that members patronize their cooperative to increase their individual farm profits. Cash payments on deferred patronage refunds and other economic benefits of membership serve as inducements to participation and are maximized over the anticipated period of membership in each individual case.

The maximization of the net benefits of membership over time was accomplished within a specified structure of (1) available technology and (2) resource, market and financing limitations using the linear programming approach. Four unique financing situations were used to specify the input-output relationships, which were affected by (1) the competitive market position of the cooperative, and (2) the nature of its management. Lack of quantitative information on these factors required the use of the four generalized financing situations as a first approximation to the "true" economic conditions in a specific case..

Basic data to test the analytical models were obtained from two

main sources: (1) financial and operating statements of a sample of cooperative elevator associations audited by the Farmers Grain Dealers Association of Des Moines, Iowa, over a period of four to ten years, including fiscal years ending during the 1953-54 marketing season, and (2) field survey of 160 members in either cooperative elevator associations. A population of 172 cooperative elevator associations were stratified into two levels of average net savings over a four year period and two levels of change in total assets over the same period, i.e., fiscal years ending October 1, 1950 to September 30, 1953. Samples of 86,32 and 8 associations were obtained for historical and cross-sectional analyses. In addition, supplementary financing data were obtained by mail questionnaires from selected elevators in the sample of 86 associations.

Multiple regression equations were derived, using the least squares method, which provided the merchandising coefficients to describe the input-output relationships for each financing situation. Unit values, or prices, were also estimated for each financing and merchandising group, using the same methodological procedure. Finally, quantitative measures of requirements and limiting factors were obtained from the membership survey and the financial and operating statements of elevator associations in the sample.

Limitations to the growth and expansion of farmer elevator associations were examined. Market, resource and financing limitations were evaluated in terms of their historical origins, measurement, and impact upon the size and nature of the cooperative association. The limitations were identified with policy considerations in the cooperative association, but the level of management was a critical variable in the structure of

limitational factors.

Specific member limitations included (1) the structure of member preferences, (2) the collateral and other financing requirements of lending institutions, (3) the state laws pertaining to farmer cooperatives, and (4) the productivity of capital on member farms. The preliminary applications show the importance of the first of these limitations, i.e., the structure of member preferences. Member preferences, particularly the financing preferences between equity financing and indebtedness, were as restrictive as the market limitations in certain cases in establishing the over-all organization of the cooperative.

The linear programming applications were intended to illustrate the methodology and data requirements of the technique. The most useful applications will involve a specific cooperative with a unique set of resources, market potentials, financing restrictions and technology. Moreover, the linear programming matrix should provide for a capital expenditures program as well as a merchandising program and a financial program. Each of the needed improvements in the application of the technique is feasible, however, within the proposed analytical framework.

The analytical approach, employing the technique of activity analysis or linear programming, has tremendous potential application. Anticipated future improvements in available data and computational facilities and procedures will make possible the application of the approach to financing and other management and planning problems of cooperative associations. It is a realistic and practical approach, insofar as it involves, not merely the quantitative measure of the technology employed in a particular elevator, but the restrictions that limit the use of the available tech-

nology. It will be possible to show the loss in net membership benefits as a result of the various market, resource and financing limitations. Avenues for improvement of the economic environment of cooperatives will be suggested by the linear programming results. The management, the directors and the members of the cooperative association may relate the suggested improvements to their structure of preferences and purposes in membership. The suggested improvements may be discarded, but the decision can be made in light of a host of relevant factors.

Two specific recommendations are made in view of the limitations and possibilities of the proposed analytical technique: (1) Research on the management factor in farmer cooperatives; (2) Research on factors affecting the competitive position of farmer cooperatives. The research findings in the areas of management and industry structure would make possible the application of a general programming approach to specific financing and other organizational problems of farmer cooperatives.

Finally, the place of membership education in the purposes, business operations, and economic possibilities of farmer cooperatives cannot be over-emphasized. The survey data cited in the first pasrt of this study emphasized the wide gap between present membership participation and the level of participation assumed in the analytical model.

ACKNOWLEDGEMENT

The author is grateful to Professor Richard Phillips for advice and criticism on the preparation and review of the study and to Professor Frank Robotka, who gave generously of his time and experience in clarifying the problems of farmer cooperatives.

APPENDIX

Appendix tables include basic data pertaining to (1) the population of 172 elevator associations, and (2) the population of members in eight of the 172 elevator associations.

Summary operating and financing data for the samples of 8, 32 and 86 elevators involved in the study are presented in Tables 53 to 76. Tables 53 to 60 pertain to the sample of 32 elevators analyzed over a 10 year period, including the 1953-54 marketing season. Only the last eight of the fiscal years analyzed are included in the summary tables. Tables 61 and 62 show comparable summary data for the eight elevator associations in the field survey of members. Tables 63 to 68 include regression coefficients and related statistics used to derive the merchandising and financing coefficients in the linear programming matrices. Tables 69 to 76 present the relevant regression coefficients for gross operating margins and fixed assets by financing situation.

Quantitative data on member preferences are presented in Tables 77 to 81. The tables summarize selected data on investment, financing, liquidity, and time preferences according to four criteria, i.e., total acres of land farmed, acres owned, months of labor used on farm and age of farm operator. It is assumed, in the presentation of the five tables, that the specified preferences are not significantly different when grouped according to attendance at annual meetings, capital position and elevator association.

Table 53. Summary balance sheet for eight cooperative elevator associations in financing situation Aa. Average value per association by specified group and fiscal, 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
				(thousand dollars)				
Assets								
Current assets	43.2	44.6	41.4	43.2	51.9	53.3	49.4	63.7
Investments	6.0	9.0	14.5	14.1	14.2	16.9	17.2	17.4
Other investments	3.5	1.0	1.2	1.1	0.8	0.8	1.6	1.5
Fixed assets, gross	28.3	39.7	45.8	53.3	63.8	66.6	67.2	77.2
Total gross assets	81.0	94.3	102.9	111.7	130.7	137.6	135.4	159.8
Depreciation reserve	13.1	14.1	15.9	17.8	19.7	22.8	25.5	28.1
Total net assets	67.9	80.2	87.0	93.9	111.0	114.8	109.9	131.7
Liabilities and equity								
Notes payable	0	0	2.1	1.1	3.2	5.4	3.1	7.7
Other current liabilities	6.0	8.6	3.3	3.9	8.5	6.6	6.1	8.7
Loans	0	0	0	1.8	6.6	5.5	4.2	5.9
Total liabilities	6.0	8.6	5.4	6.8	18.3	17.5	13.4	22.3
Membership	2.9	3.0	2.6	2.9	3.0	3.1	3.2	3.2
Preferred stock	2.2	1.6	1.8	5.0	4.9	4.8	4.8	4.7
Patronage refunds	32.6	40.7	52.2	53.8	57.9	61.4	61.1	70.9
Surplus	24.2	26.3	27.9	25.4	26.9	28.0	27.4	30.6
Total equity	61.9	71.6	81.6	87.1	92.7	97.3	96.5	109.4
Total liabilities and equity	67.9	80.2	87.0	93.9	111.0	114.8	109.7	131.7

Table 54. Summary balance sheet for selected cooperative elevator associations in financing situation Ab. Average value of specified assets, liabilities and equity per association by specified group and fiscal year, 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
	(thousand dollars)							
Assets								
Current assets	52.2	63.8	45.9	41.8	52.6	63.7	62.0	63.8
Investments	8.8	14.8	17.8	18.8	19.7	25.2	28.1	30.4
Other investments	2.6	2.6	2.3	0.2	0.2	0.3	1.8	1.6
Fixed assets, gross	24.0	29.0	38.5	42.6	47.1	55.7	71.4	82.2
Total gross assets	87.6	110.2	104.5	103.4	119.6	144.9	163.3	178.0
Depreciation reserve	14.5	15.4	14.2	13.8	15.9	18.3	20.9	24.2
Total net assets	73.1	94.8	90.3	89.6	103.7	126.6	142.4	153.8
Liabilities and equity								
Notes payable	0	1.3	1.5	5.0	3.5	3.6	5.4	6.6
Other current liabilities	4.0	5.1	4.0	3.0	5.0	5.9	10.9	11.2
Loans	0.3	3.5	4.7	2.6	3.2	8.8	13.5	13.0
Total liabilities	4.3	9.9	10.2	10.6	11.7	18.3	29.8	30.8
Memberships	4.7	5.0	4.7	4.4	4.3	5.2	4.5	4.5
Preferred stock	1.1	1.2	3.8	6.2	6.3	5.8	13.1	13.3
Deferred refunds	32.5	45.9	41.3	40.4	51.7	65.5	65.2	74.2
Surplus	30.5	32.8	30.3	28.0	29.7	31.8	29.8	31.0
Total equity	68.8	84.9	80.1	79.0	92.0	108.3	112.6	123.0
Total liab. and equity	73.1	94.8	90.3	89.6	103.7	126.6	142.4	153.8

Table 55. Summary balance sheet for selected cooperative elevator associations in financing situation Ba. Average value of specified assets, liabilities and equity per association by specified group and fiscal year, 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
	(thousand dollars)							
Assets								
Current assets	87.6	113.8	107.7	111.2	118.2	131.1	112.8	120.2
Investments	13.3	18.5	25.0	28.0	28.0	32.4	36.8	38.6
Other investments	3.2	3.2	3.2	3.2	3.3	3.3	3.8	2.4
Fixed assets, gross	59.6	66.1	72.4	84.4	92.6	98.2	103.6	126.7
Total gross assets	163.7	201.6	208.3	226.8	242.1	265.0	257.1	287.9
Depreciation reserve	20.5	22.8	24.9	27.9	31.4	35.2	39.7	47.4
Total net assets	143.2	178.8	183.4	198.9	210.7	229.8	217.3	240.5
Liabilities and equity								
Notes payable	0.6	0	0.6	3.3	1.5	8.1	9.1	18.2
Other current liabilities	13.2	21.6	13.9	13.4	14.3	21.8	13.6	19.7
Loans	0	0	0	0	0	0	0	3.8
Total liabilities	13.8	21.6	14.5	16.7	15.8	29.9	22.7	41.8
Memberships	17.0	17.0	17.7	18.5	18.9	15.8	16.2	15.8
Preferred stock	7.7	10.8	12.4	11.9	11.5	27.9	33.8	35.4
Patronage refunds	61.2	82.9	84.9	93.2	100.0	97.6	83.3	83.5
Surplus	43.5	46.5	53.9	58.6	64.5	58.6	61.3	64.1
Total equity	129.4	157.2	168.9	182.2	194.9	199.9	194.6	198.8
Total liab. and equity	143.2	178.8	183.4	198.9	210.7	229.8	217.3	240.5

Table 56. Summary balance sheet for selected cooperative elevator associations in financing situation Bb. Average value of specified assets, liabilities and equity per association by specified group and fiscal year, 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
	(thousand dollars)							
Assets								
Current assets	69.0	65.3	68.9	87.5	113.8	152.0	163.0	180.0
Investments	9.9	15.8	24.2	29.2	32.7	35.9	59.1	42.1
Other investments	1.3	0.9	0.9	0.9	0.3	0.4	0.3	0.3
Fixed assets, gross	41.3	43.6	48.6	64.9	120.2	134.6	151.4	164.2
Total gross assets	121.5	125.6	142.6	182.[illegible]	267.0	322.9	353.8	386.7
Depreciation reserve	13.3	13.6	14.6	16.4	28.6	33.4	38.2	44.2
Total net assets	108.2	112.0	128.0	166.4	238.4	289.5	315.6	342.5
Liabilities and equity								
Notes payable	2.5	1.1	2.5	7.3	7.2	6.9	9.7	7.0
Other current liabilities	6.3	5.3	6.4	8.4	11.4	24.7	23.7	27.3
Loans	0	0	0	8.9	15.1	12.2	18.2	18.8
Total liabilities	8.8	6.4	8.9	24.6	33.7	43.8	51.6	53.1
Memberships	6.0	7.3	7.2	8.0	8.8	9.6	10.5	11.1
Preferred stock	15.5	9.9	14.3	13.1	17.3	20.7	29.7	32.6
Patronage refunds	55.8	63.1	70.4	89.0	128.3	159.2	164.0	180.8
Surplus	22.1	25.3	27.2	31.7	50.3	56.2	59.8	64.9
Total equity	99.4	105.6	119.1	141.8	204.7	245.7	264.0	289.4
Total liab. and equity	107.2	112.0	128.0	166.4	238.4	289.5	315.6	342.5

Table 57. Summary operating statement for eight cooperative elevator associations in financing situation Aa. Average value of specified assets, liabilities and equity per association, by specified group and fiscal year ending 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
	(thousand dollars)							
Sales								
Grain sales	454.2	358.9	279.2	247.9	347.0	348.1	316.5	318.8
Sideline sales	68.4	99.6	84.5	96.4	111.2	118.0	124.6	131.4
Total	522.6	458.6	363.6	344.3	458.2	466.1	441.1	450.2
Income								
Commodity margins	28.5	25.2	19.8	21.4	25.6	24.4	23.3	28.0
Other income	3.3	3.5	6.1	10.0	8.1	7.5	5.2	12.4
Patronage refunds earned	3.3	5.2	5.5	2.8	1.6	2.4	1.4	1.4
Total	35.1	33.9	31.4	34.2	35.3	34.3	29.9	41.8
Operating expenses								
Manager's salary	2.9	3.5	3.4	3.6	3.8	4.0	4.3	4.3
Labor	5.7	6.3	5.4	7.1	8.4	9.1	9.2	10.0
Depreciation	1.2	1.5	1.7	2.4	2.7	3.1	3.4	3.4
Interest	0.1	0	0.1	0.1	0.3	0.5	0.6	0.5
Other	4.9	5.2	5.1	7.2	8.5	8.6	8.2	8.9
Total	14.8	16.5	15.7	20.4	23.7	25.3	25.7	27.1
Total net savings	20.3	17.4	15.7	15.8	11.6	9.0	4.2	14.7

Table 58. Summary operating statement for eight cooperative elevator associations in financing situation Ab. Average value of specified sales, income and operating expenses per association, by specified group and fiscal year ending 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
	(thousand dollars)							
Sales								
Grain sales	384.2	452.0	303.7	197.8	307.2	381.3	379.8	298.5
Sideline sales	111.8	155.1	155.3	157.8	151.8	167.9	174.7	207.1
Total	496.0	607.0	459.0	355.6	458.9	549.2	554.5	505.6
Income								
Commodity margins	31.4	33.8	24.7	23.2	29.4	33.0	32.3	33.4
Other income	1.9	1.6	2.6	6.1	7.1	7.1	6.7	14.5
Patronage refunds earned	4.6	7.4	7.2	4.5	2.8	6.2		3.2
Total	37.9	42.8	34.5	33.8	39.3	46.3	42.7	51.1
Operating expenses								
Manager's salary	3.1	2.9	3.5	3.4	3.9	4.7	4.5	4.9
Labor	6.3	7.8	7.9	7.9	9.3	10.7	12.3	13.7
Depreciation	0.8	1.0	1.3	1.9	2.2	2.5	2.9	3.7
Interest	0.1	0.1	0.2	0.3	0.4	0.5	0.7	0.8
Other	4.0	4.3	4.8	6.3	8.0	9.7	10.8	11.8
Total	14.3	16.1	17.7	19.8	23.8	28.1	31.2	34.9
Total net savings	23.6	26.7	16.8	14.0	15.5	18.2	11.5	16.2

Table 59. Summary operating statement for eight cooperative elevator associations in financing situation Ba. Average value of specified sales, income and operating expenses per association, by specified group and fiscal year ending 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
				(thousand dollars)				
Sales								
Grain sales	596.1	805.8	484.7	455.3	597.5	642.4	609.9	518.5
Sideline sales	199.9	254.8	283.7	303.2	319.9	349.4	322.4	331.8
Total	796.0	1060.6	879.4	758.5	917.4	991.8	932.3	850.3
Income								
Commodity margins	58.0	67.2	65.0	65.2	74.2	75.7	60.2	59.7
Other income	6.3	7.6	8.2	15.8	14.8	11.6	12.0	20.6
Patronage refunds earned	7.3	8.0	10.5	7.1	4.2	7.0	3.8	4.2
Total	71.6	82.8	83.7	88.1	93.2	94.3	76.0	84.5
Operating expenses								
Manager's salary	4.4	5.1	5.2	5.3	5.7	5.9	5.9	6.1
Labor	10.6	13.5	15.3	17.3	19.2	21.8	21.5	21.7
Depreciation	2.6	2.8	3.4	3.9	4.4	4.8	5.3	5.6
Interest	0.1	0.1	0.1	0	0.4	0.4	0.5	0.5
Other	9.0	9.6	11.1	11.6	11.9	14.3	14.5	15.7
Total	26.7	31.1	35.1	38.1	41.6	47.2	47.7	49.6
Total net savings	44.9	51.7	48.6	50.0	51.6	47.1	28.3	34.9

Table 60. Summary operating statement for eight cooperative elevator associations in financing situation Bb. Average value of specified sales, income and operating expenses per association, by specified group and fiscal year ending 1946-47 to 1953-54

Group	1946-47	1947-48	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54
	(thousand dollars)							
Sales								
Grain sales	748.2	800.1	557.0	399.8	644.5	719.8	634.1	592.6
Sideline sales	150.3	176.8	203.4	231.4	347.8	381.7	419.1	482.6
Total	898.5	976.8	760.5	631.2	992.3	1101.5	1053.2	1075.2
Income								
Commodity margins	56.1	46.3	45.2	44.2	72.3	79.4	74.4	85.9
Other income	4.0	4.3	8.8	18.0	19.6	23.4	19.7	32.0
Patronage refunds earned	3.3	10.2	11.2	6.6	4.1	6.9	5.3	5.3
Total	63.4	60.8	65.2	68.8	96.0	109.7	99.2	123.2
Operating expenses								
Manager's salary	3.9	4.5	4.0	3.9	5.2	5.8	6.0	6.2
Labor	8.7	11.0	14.0	15.6	21.0	25.5	28.1	35.7
Depreciation	1.5	2.1	2.7	3.3	5.1	5.8	6.3	7.3
Interest	0.1	0.1	0.1	0.5	0.8	1.0	0.9	1.3
Other	7.7	9.0	10.8	11.1	15.7	19.4	20.9	23.7
Total	21.9	26.7	31.6	34.4	47.8	57.5	62.2	74.2
Total net savings	41.5	34.1	33.6	34.4	48.2	52.2	37.2	49.0

Table 61. Summary balance sheet for eight farmers' elevator associations. Average value of specified assets, liabilities and operating expenses per association by specified group and elevator association, fiscal year ending October 1, 1953 to September 30, 1954

Group	Elevator association							
	Aa1	Aa2	Ab1	Ab2	Ba1	Ba2	Bb1	Bb2
	(thousand dollars)							
Assets								
Current assets	50.6	53.6	72.2	100.3	121.1	78.3	162.0	157.2
Investments	21.9	10.1	25.7	62.0	27.2	24.8	50.8	41.7
Other investments	0.5	1.0	0	1.5	0	2.8	0	0
Fixed assets, gross	108.6	96.4	75.3	131.5	78.1	83.1	67.9	226.6
Total gross assets	181.6	161.1	173.2	295.3	226.4	189.0	280.7	425.5
Depreciation reserve	25.5	29.9	14.6	38.0	26.4	47.7	17.9	70.2
Total net assets	156.1	131.2	158.6	257.3	200.0	141.3	263.8	355.3
Liabilities and equity								
Notes payable	45.4	10.0	7.2	25.0	0.1	0	0	0
Other current liabilities	7.2	6.7	35.1	16.4	10.5	10.6	34.8	21.9
Loans	26.5	0	19.2	0	0	0	0	0
Total liabilities	79.1	16.7	61.5	41.4	10.6	10.6	34.8	21.9
Memberships	1.6	2.9	3.1	3.9	17.2	6.9	10.4	20.5
Preferred stock	0	0	41.8	0	94.9	0	44.1	54.3
Patronage refunds	49.8	78.1	44.2	172.6	30.1	46.1	130.3	170.3
Surplus	25.6	33.0	8.0	39.4	47.2	77.5	43.2	86.3
Total equity	77.0	114.5	97.1	215.9	189.4	130.5	228.0	333.4
Total liab. and equity	156.1	131.2	158.6	257.3	200.0	141.1	262.8	355.3

Table 62. Summary operating statement for eight farmers' elevator associations. Average value of specified sales, income and operating expenses per association, by specified group and elevator association, fiscal year ending October 1, 1953 to September 30, 1954

Group	Elevator association							
	Aa1	Aa2	Ab1	Ab2	Ba1	Ba2	Bb1	Bb2
	(thousand dollars)							
Sales								
Grain sales	338.3	172.5	362.1	392.9	386.2	318.8	370.1	595.3
Sideline sales	42.6	158.9	250.4	291.0	559.1	276.1	439.5	478.5
Total	380.9	331.4	612.5	683.9	945.3	594.9	809.6	1073.8
Income								
Commodity margins	6.6	28.8	29.7	46.4	91.6	58.8	57.0	101.2
Other income	16.7	11.8	16.0	9.3	3.0	16.9	13.0	30.8
Patronage refunds earned	1.6	1.8	3.9	3.9	2.0	4.3	4.1	6.3
Total	24.9	42.4	59.6	59.6	96.6	80.0	74.1	138.3
Operating expenses								
Labor	8.2	18.2	20.5	27.4	34.8	31.3	28.9	44.3
Depreciation	2.1	4.9	4.7	5.4	3.4	4.3	4.4	8.6
Interest	1.4	1.0	1.3	0.2	0.5	0	0	0.6
Other	7.6	8.5	14.2	15.7	14.3	12.0	13.9	28.2
Total	19.3	32.6	40.7	48.7	53.0	47.6	47.2	81.7
Distribution of net savings								
Income taxes	0.2	0.1	1.8	0.5	4.0	2.0	3.1	3.9
Dividends	0	0.4	2.1	0	4.5	0	2.2	3.1
Patronage refunds	3.8	8.3	13.0	9.2	30.2	25.9	19.3	43.6
Surplus	1.6	0.8	2.0	1.2	4.9	4.5	2.3	6.0
Total	5.6	9.8	18.9	10.9	43.6	32.4	26.9	56.6

Table 63. Regression coefficient for grain sales, sideline sales and other income, by prediction variable, 86 elevator associations, 1953-54[a]

Dependent variable	Grain sales b_1	Sideline sales b_2	Other income b_3	Constant b_4
Labor expense	.1379	.4683	.2068	.1915
Other expense	.1859	.3534	.2444	.1320
Current assets	.4264	.3134	.3291	-.4872
Grain margins	.7544	.1102	.0089	-.7760
Sideline margins	-.2035	.1500	.0645	-2.7393
Patr. refunds earned	.6182	.3770	.3209	-3.4761
Current liabilities	.1461	.3913	.2330	.3262
Surplus allocation	-.0939	.5414	.9227	-2.8965
Operating expense	.1531	.4282	.2202	.4632
Depreciation expense	.2779	.3654	.2566	-.9286

[a]Regression coefficients show the percent change in the dependent variable associated with a one percent change in the specified independent variable.

Table 64. Selected statistics, including student's "t" values for specified regression coefficients, by prediction variable, 6 elevator associations, 1953-54[a]

Prediction variable	Grain sales b_1	Sideline sales b_2	Other income b_3	Coefficients of determination
Labor expense	2.44	11.64	4.63	0.77
Other expense	3.30	8.81	5.48	0.73
Current assets	3.56	7.34	3.62	0.65
Fixed assets	6.36	6.55	6.19	0.76
Grain margins	6.90	1.41	0.10	0.46
Sideline margins	4.35	3.72	2.85	0.90
Current liabilities	1.01	3.79	2.03	0.30
Surplus allocations	6.36	2.89	4.43	0.35
Operating expense	2.96	11.61	5.37	0.79
Depreciation expense	4.91	9.05	5.72	0.77

[a]Regression coefficients show the percent change in the dependent variable associated with a one percent change in the specified independent variable.

Table 65. Regression coefficient for grain sales, sideline sales and other income, by prediction variable, 86 elevator associations, 1953-54[a]

Dependent variable	Grain sales b_1	Sideline sales b_2	Other income b_3	Constant b_0
Total assets	.1568	.3203	3.4750	-7,645
Net savings	.0191	.0645	.5660	2,540

[a]Regression coefficients show the units change in the dependent variable associated with a one unit change in the specified independent variable.

Table 66. Selected statistics, including student's "t" values for specified regression coefficients, by prediction variable, 86 elevator associations, 1953-54[a]

Dependent variable	Grain sales	Sideline sales	Other income	Coefficient of determination
Total assets	6.56	11.28	8.30	0.88
Net savings	3.07	8.74	5.20	0.76

[a]Regression coefficients show the units change in the dependent variable associated with a one unit change in the specified independent variable.

Table 67. Regression coefficient for grain sales, sideline sales and other variables, by prediction variable, 52 elevator associations, 1954[a]

Dependent variable	Grain sales	Side-line sales	Line of credit	Notes payable	Deferred lia-bilities	Constant (1)	Multiple regression coefficient
Cash	.0086	.0278	-.0623	.0546	none	10,599	0.27
Receivable	.0154	.0875	none	-.1068	-.1397	1,586	0.61
Inventory	.0138	.1422	none	none	none	3,337	0.98

[a]Regression coefficients show the units change in the dependent variable associated with a one unit change in the specified independent variable.

Table 68. Regression coefficient amount of peak loans on specified variables, 32 elevator associations, 1945-1954[a]

Dependent variable	Fixed assets b_1	Current assets b_2	Net savings b_3	Permanent capital b_4	Coefficient of determination
Peak loans	-.0378	-.5047	.1413	.3547	0.30

[a]Regression coefficients show units change in peak loans with one unit change in specified independent variable.

Table 69. Fixed assets requirement. Regression coefficients for grain sales, including 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	.2158	.2315	.3184	.0737	.4264
Lower limit	-.0046	-.1694	-.0953	-.1282	.2929
Upper limit	.4362	.6324	.7321	.2756	.5599

Table 70. Fixed assets requirement. Regression coefficients for sideline sales, including 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	.3010	.2297	.4007	.0673	.3134
Lower limit	.2434	-.3020	-.3929	-.1730	.2183
Upper limit	.3586	.7614	1.1943	.3076	.4085

Table 71. Fixed assets requirement. Regression coefficients for other income, including 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	.3211	.4889	.2404	.2552	.3291
Lower limit	.1742	-.2437	-.0248	.1301	.2233
Upper limit	.4680	1.2215	.5056	.3803	.5529

Table 72. Fixed assets requirement. Regression coefficients for initial sale, including 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	.6843	.4433	.0328	3.2409	-.4872
Upper limit	.5739	.2980	-.1497	3.2118	-.5221
Lower limit	.7947	.5868	.2153	3.2700	-.4523

Table 73. Gross grain operating proceeds. Regression coefficients for grain sales, including values at 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	.6881	.7813	1.0083	.5475	.7967
Lower limit	.3656	.4687	.6482	.0509	.6045
Upper limit	1.0106	.0939	1.3684	1.0441	.9889

Table 74. Gross grain operating proceeds. Regression coefficients for initial sale, including values at 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	.1541	-.3935	-1.5475	1.1039	-.3879
Lower limit	.0578	-.4770	-1.6375	.9688	-.4442
Upper limit	.2495	-.3100	-1.4575	1.2390	-.3316

Table 75. Gross sidelines operating proceeds. Regression coefficients for sideline sales, including values at 95 percent confidence limits, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	1.7573	1.0874	1.1192	1.1324	1.4827
Lower limit	1.4605	.8888	.9262	1.0163	1.3730
Upper limit	2.0541	1.2860	1.3122	1.2485	1.5924

Table 76. Gross sidelines operating proceeds. Regression coefficients for initial sale, including values at 95 percent confidence limits and related statistics, by financing situation, fiscal year ending 1953-54

Item	Financing situation				Total
	Aa	Ab	Ba	Bb	
Mean value	-4.8856	-1.3865	-1.5428	-1.6109	-4.5690
Lower limit	-5.0433	-1.4295	-1.5766	-1.6384	-4.6117
Upper limit	-4.7279	-1.3435	-1.5090	-1.5834	-4.5263

Table 77. Investment preference of farmer members. Average amount per member transferred to farm from a safe investment of 10,000 dollars, by specified interest rate, land input group, labor input group, land ownership group and age group.[a][b]

Land input group	Land ownership group		Low labor		High labor	
			Low age	High age	Low age	High age
			(thousand dollars)			
Low land	Low ownership	(1)	6.8 (23)	6.0 (3)	7.5 (3)	7.6 (5)
		(2)	5.6 (23)	2.8 (3)	6.5 (3)	5.9 (5)
		(3)	4.1 (23)	2.0 (3)	4.0 (3)	4.0 (5)
		(4)	2.0 (23)	- (3)	2.8 (3)	2.3 (5)
	High ownership	(1)	7.5 (7)	6.7 (13)	4.9 (5)	6.3 (15)
		(2)	4.9 (7)	5.5 (13)	3.4 (5)	4.2 (14)
		(3)	2.2 (7)	4.0 (13)	2.4 (5)	1.8 (14)
		(4)	- (7)	2.0 (12)	1.1 (5)	0.7 (13)
High land	Low ownership	(1)	6.9 (11)	4.4 (5)	6.1 (16)	6.1 (12)
		(2)	5.2 (11)	3.0 (5)	5.0 (16)	4.5 (12)
		(3)	3.6 (11)	1.1 (5)	3.3 (16)	2.5 (12)
		(4)	1.5 (11)	0.5 (5)	1.2 (16)	0.8 (11)
	High ownership	(1)	8.0 (8)	6.0 (7)	7.1 (6)	7.9 (14)
		(2)	6.3 (8)	3.7 (7)	6.0 (6)	6.1 (14)
		(3)	4.4 (8)	1.8 (7)	2.8 (6)	3.7 (14)
		(4)	2.1 (8)	0.1 (7)	0.9 (6)	2.1 (14)

[a]Interest rates on the safe investment are as follows: (1) 3 percent; (2) 5 percent; (3) 7 percent; (4) 10 percent.

[b]Data in parentheses are the number of respondents for the specified group by land input, land ownership, labor input, age and interest rate.

Table 78. Investment preference of farmer members. Average amount per member transferred to cooperative from a safe investment of 10,000 dollars, by specified interest rate, land input group, labor input group, land ownership group and age group.[ab]

Land input group	Land ownership group		Low labor		High labor	
			Low age	High age	Low age	High age
			(thousand dollars)			
Low land	Low ownership	(1)	5.7 (23)	1.3 (3)	7.3 (3)	4.0 (5)
		(2)	4.5 (23)	0.8 (3)	6.3 (3)	3.6 (5)
		(3)	3.3 (23)	- (3)	4.2 (3)	2.9 (4)
		(4)	2.2 (23)	- (3)	2.8 (3)	1.5 (4)
	High ownership	(1)	5.3 (6)	3.5 (13)	5.2 (5)	4.0 (12)
		(2)	3.7 (6)	2.3 (13)	3.4 (5)	1.5 (12)
		(3)	1.6 (6)	1.2 (13)	2.4 (5)	0.9 (12)
		(4)	0.8 (6)	0.8 (13)	1.5 (5)	0.6 (12)
High land	Low ownership	(1)	5.0 (11)	1.9 (5)	3.6 (16)	3.6 (12)
		(2)	4.0 (10)	1.2 (5)	3.5 (16)	2.7 (12)
		(3)	3.1 (10)	0.4 (5)	2.3 (16)	1.8 (12)
		(4)	1.4 (10)	0.4 (5)	3.0 (16)	0.8 (12)
	High ownership	(1)	5.2 (8)	2.9 (7)	6.3 (5)	3.4 (14)
		(2)	4.0 (8)	2.2 (7)	5.4 (5)	2.4 (14)
		(3)	3.3 (8)	1.7 (7)	3.4 (6)	1.1 (14)
		(4)	2.4 (8)	1.1 (7)	1.5 (6)	0.8 (14)

[a]Interest rates on the safe investment are as follows: (1) 3 percent; (2) 5 percent; (3) 7 percent; (4) 10 percent.

[b]Data in parentheses are the number of respondents for the specified group by land input, land ownership, labor input, age and interest rate.